IMPORTANCE AND UTILIZATION OF SPECIALIZED COMPETENCE WITHIN A MATRIX ORGANIZATIONAL ENVIRONMENT

THESIS

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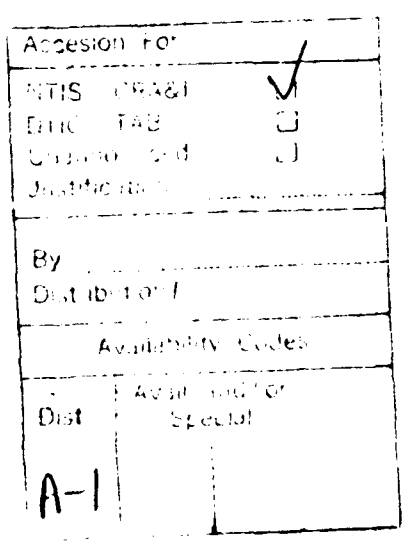

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Abstract

This study explored how the productivity of a configuration and data management division within a matrix organization can be improved and subsequently recommended strategies for increased productivity. A modified Wagner and Morse questionnaire facilitated data collection. Information and ratings were gathered through personal interviews with the configuration and data managers and their respective program managers (matched-pair) concerning specialized competence, aptitude, utilization and importance. Additionally, this study identified situational factors which may serve to increase a configuration and data manager's competence rating.

Significant findings of this research were: (1) the configuration and data manager is relatively insignificant when compared to other functional program personnel; (2) there are few sufficiently knowledgeable configuration and data management personnel; (3) the program manager possesses an inadequate understanding of the duties performed by a configuration and data manager; and (4) utilization of a configuration and data manager is unrelated to the individual's competency level.

Two alternative recommendations were proposed for increased productivity and efficiency of the configuration and data management area:

The first recommendation proposes a major re-structuring of the existing configuration and data management support structure by which configuration and data managers would be transferred to work in the system program office.

The second recommendation proposes that the current organizational structure in which the configuration and data management personnel work in not be disrupted.

Four strategies for enhanced productivity are subsequently proposed to assist in the implementation of either recommendation.

IMPORTANCE AND UTILIZATION OF SPECIALIZED COMPETENCE WITHIN A MATRIX ORGANIZATIONAL ENVIRONMENT

I. Introduction

The Research Goal

The goal of this study is to investigate factors within a matrix structured organization which may, either by themselves or cumulatively, decrease organizational productivity. Factors and relationships to be investigated throughout the course of this research project include role ambiguity, intrinsic (self-perceived) and extrinsic (other-perceived) aptitude, specialized competence, role importance, and consequential role utilization. The desired outcome of this research is to identify potential solutions to the problem of limited productivity and, subsequently, to recommend strategies for enhanced organizational productivity within a matrixed structured environment.

General Problem

Central to the concept of system acquisition management is the designation of a single program manager whose responsibilities include both technical and business aspects of the acquisition program. The program manager is responsible for assembling a support team, gathered from

personnel in appropriate functional areas, to assist in accomplishing the program objectives. Within a matrix organization, program expertise is provided by specialized individuals from functional divisions of the organization. The program manager is given the authority required to fulfill his responsibilities as manager and is ultimately held accountable for accomplishing the total management task (23:1-2). The delegation of roles and associated responsibilities to functional personnel of the management team is at the discretion of the program manager. Each functional division, therefore, has defined roles and critical responsibilities based on the divisional expertise. Previous research indicates that the effectiveness of a program manager is directly related to the collective competencies, knowledge and skills of the representative functional division team members (31). Therefore, it can be inferred that the program manager's (extrinsic) perception of an individual functional member's specialized competency will be based on the demographics (education, experience, etc.) related to competence level and will be reflected by the degree to which the knowledge and skills of the functional member are relied upon and utilized by the program manager. However, since "the chain is only as strong as its weakest link", the tendency of many program managers to use their own "functional competence" instead of

utilizing a functional person who is perceived as non-competent may not strengthen the program management team at all. Thus, the way a program manager determines functional competence and/or decides to utilize a functional can be critical to improving the effectiveness of program management.

Providing some information on the perceived competence level and utilization of acquisition personnel is a study conducted by Captain Miller (1987). Miller's research identifies competence indicators which may relate to perceived competence. These indicators included intrinsic [self-perceived] aptitude, formal education, program acquisition phase and relative importance of specialized competence (24:8-10).

Among Miller's competence indicators is intrinsic aptitude. For the purpose of this research, aptitude may be defined as an individual's ability to assimilate new information as well as the natural tendency to personally engage in other than familiar areas and issues. Intrinsic aptitude, according to his conclusions, may have a direct positive correlation with perceived specialized competence (24:8). An individual's aptitude may be measured by determining the individual's ability and readiness to learn new, program-related, technical information and by examining the propensity to ask questions which pertain to program issues outside their functional area.

Educational status, on the other hand, may not be a valid indication of an individual's intrinsic abilities or inclinations, according to Miller's research conclusions. Contrary to Miller's conclusions, however, previous research by Ekpo concluded that the higher one's educational status, the higher the self-estimate he makes of his profession of job relevant abilities (13:411). Assuming that an individual must assimilate information from a variety of sources including personal and job experiences, in addition to formal education, it may be that cumulative experiences rather than formal education alone, may serve as an indication of competency. Whether or not a positive correlation exists between an individual's educational status and perceived competence is one issue to be addressed by this project.

The program acquisition phase, Miller's third indication of competence, may be an important determining factor as to whether or not specialized competence is required. Supporting Miller's conclusion regarding acquisition phase is research conducted by Baumgarter who concludes that a high level of competence may gain critical importance as acquisition programs progress through later phases which involve advanced technology (3:36). Further support that program phase is related to perceived competence is demonstrated by the research conclusions of Thamhain. He

concludes that the intensity of management conflicts, especially those associated with programmatic issues, vary significantly during different phases of an acquisition program's life cycle (31). The current research project will explore further the relationship between perceived specialized competence and phase of an acquisition program, specifically as it pertains to the matrix-structured configuration and data management division.

The fourth and final indication of competency addressed in Miller's research is relative importance of specialized competence. The relative importance of an individual functional member's belief in his abilities may be a critical factor in the utilization of the functional by the program manager in accomplishing program objectives. If a functional projects a lack of knowledge, relative to other program functionals, the program manager will also rate that functional's specialized competence as inadequate. Therefore, utilization of the functional by the program manager is likely to be minimal.

Statement of the Problem

The specific aim of this research is to determine factors, if any, which may contribute to decreased productivity within the matrixed configuration and data management functional office. Productivity will be defined as the efficient utilization of resources. Since the

criteria for determining efficiency are somewhat subjective, the organization's commander will make the final determination as to whether or not a resource is being utilized to an optimum level. The problem of decreased productivity will be addressed by examining aptitude, relative importance, the perceived specialized competence of the configuration and data manager, the utilization of this specialized competence by the respective program manager, and the organizational formalization. These factors are all primary elements which may contribute either positively or negatively to productivity of the matrix organization.

Davis stated that, in the acquisition process of a weapon system, the configuration and data management area is perceived as "secondrate" from the program manager's point of view (9). With respect to programmatic contributions, the configuration and data manager's input is perceived as less important than that of other functionals including engineering, logistics and program control (9). These perceptions, valid or not, may cause a decreased utilization of the configuration and data manager in the development of a weapon system. While it can be expected that the treatment accorded configuration and data management functionals will reflect these perceptions, decreased morale, low job satisfaction, employee turnover, etc. can be expected to result. Such associated aspects will not, however, be addressed in this research project.

Importance of the Study

The current theme for a majority of business-oriented organizations (private and public) is to "do more with less". "In order to stay competitive, a business must increase productivity 10% every year" (33). Within the Department of Defense (DoD), the forecast of constant manpower authorizations has sparked concern that the productivity and effectiveness of the DoD must increase in order to accomplish the increasing workload. Within ASD, this productivity concern is recognized and is being addressed. Further, the commander at ASD realizes that the organization cannot operate at maximum efficiency if any portion of the organization is under-utilized. This research project will explore the perceived competence, roles, and utilization of the configuration and data manager. Specifically, this research will attempt to determine means by which the productivity of the configuration and data management area can be optimized?

Research Objectives of the Study

In dealing with the problem of limited productivity within a matrix organization, this study will examine five research questions.

Research Question 1. Is the perceived specialized competence of the configuration and data manager related to his/her type of academic education?

Research Question 2. Is the perceived specialized competence of the configuration and data manager related to their intrinsic aptitude?

Research Question 3. Is the perceived importance of the configuration and data manager's specialized competence related to the specific acquisition phase of the program?

Research Question 4. Is the perceived specialized competence of the configuration and data manager related to the degree of the program manager's utilization of this specialized competence?

Research Question 5. Does the perceived specialized competence of the configuration and data manager differ significantly among ASD organizations?

Scope of this Research

Due to the fifteen-month time limitation imposed by the Air Force Institute of Technology (AFIT) program, this study will be limited to quantifiable subject matter. As noted earlier, qualitative factors of functional individuals (such as job satisfaction, retention/turnover rates, morale, and rewards) will not be considered in this study.

Definitions

Definitions are provided in Appendix A. These definitions are used specifically for this research project.

Assumptions

The following assumptions are necessary for implementation of this study:

1. The sample groups are unbiased and independent.
2. The sample groups are representative of the population from which they are drawn.
3. Survey responses and interview questions are addressed by respondents in a truthful manner, representative of the respondent's sincere feelings.
4. Organizational units to be evaluated are similar in managerial structure.

Employees within the organizational unit are generally located in the same physical location, report to the same manager and perform similar tasks (Figure 1) (7:368). Advantages of the functional management structure include efficient resource usage, advanced skill development, centralized direction and decision making, and excellent task coordination within functions.

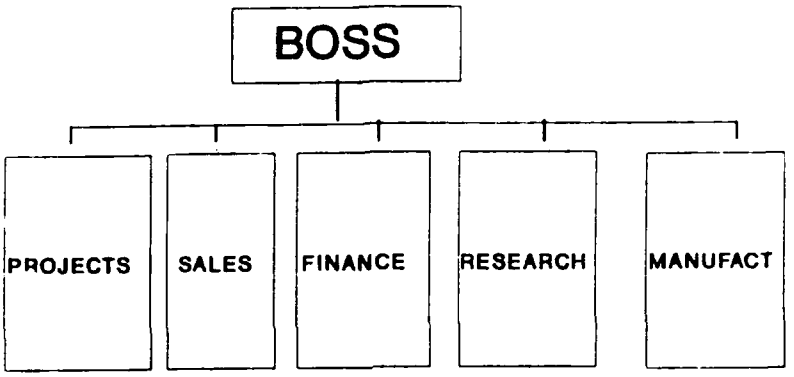

Figure 1. Functional Structure (37:47)

Weaknesses implicit to functional structuring include poor task coordination across functions, slow reaction to changing objectives, lack of technological innovation, limited general management training, and difficulty in recognizing and rewarding quality performance (7:368). Given the diversified technological requirements associated with the current business environment, the functional management structure is not the optimum organizational structure for most situations (32:1-2).

Project Organizational Characteristics. In contrast to the functional structure, the project management structure (self-contained), contains all the functional units required to complete a specified project or service (Figure 2) (7:370). The advantages of the project management structure include the ability to change program direction with a changing environment, immediate access to resources, coordination across functional units, and emphasis on product goals.

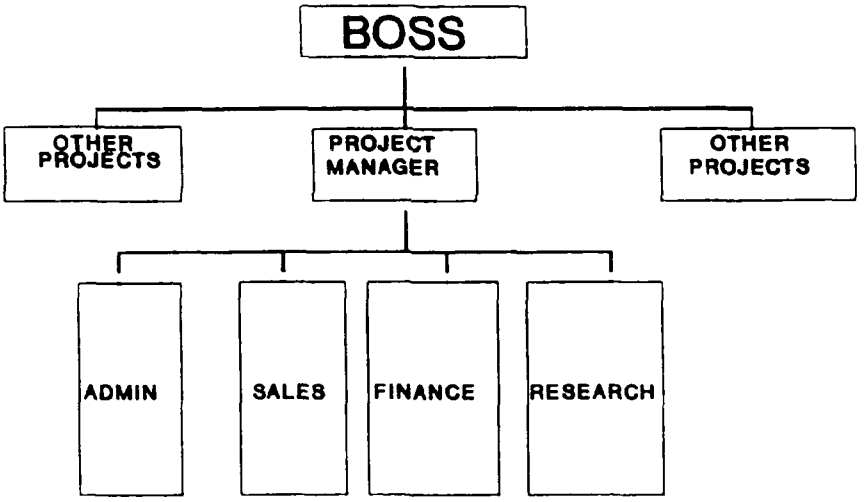

Figure 2. Project Structure (37:47)

Weaknesses implicit to the project management structure include duplication of organizational resources, non-proficient technical specialization, deficient skill development, poor coordination between product units, and de-emphasized top management decision making capability (7:375). In terms of access to resources and emphasis on

product goals, this management structure appears optimum to the client; however, the project structure may not be equally beneficial for the organization. For example, resource duplication may not be an appropriate means of achieving increased profits. Therefore, as with the functional organization, the project structural approach is not an appropriate organizational style for all applications.

The Matrix Concept

The solution then must be an optimum blend of the functional and project organizations. The hybrid has been named a matrix. Davis and Lawrence, notable in the development of matrix management theory and application, describe this management structure as a blend of the traditional (functional) and behavioral (project) management structures. Davis and Lawrence define a matrix structure as:

> any organization that employs a multiple command system that includes not only a multiple command structure but also related support mechanisms and an associated organization culture and behavior [8:3].

Expanding on the matrix concept of Davis and Lawrence, Moravec states:

> . . .visualize a matrix as a diamond-shaped entity with the general executive, such as an operations manager or possibly a division head, at the top; matrix managers who share common subordinates on the sides of the diamond; and the subordinate at the bottom. As the balancing of this diamond on its tip suggests, the top must ensure a balance of the often conflicting objectives of the managers at the sides; otherwise, the balance of decisions relating to the subordinate at the bottom is impossible [Figure 3] [25:31].

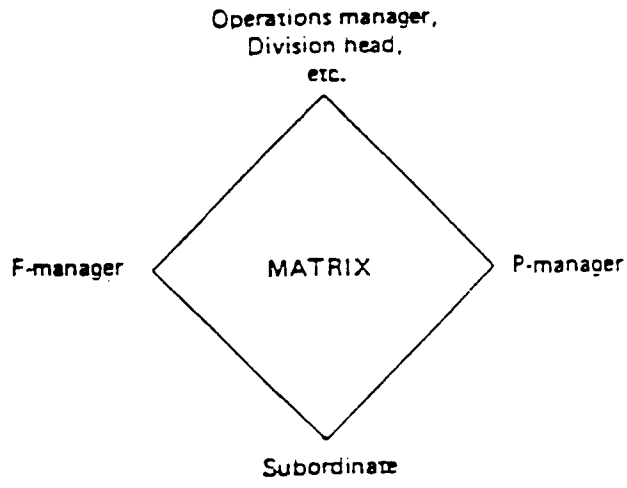

Figure 3. Matrix Model (25:32)

The significant complication of the matrix concept is the two distinct "bosses (functional and project)" at opposite but equal points. The "F-manager" is the functional manager and the "P-manager" is the project (program) manager. Each boss possesses different objectives and goals. According to Cleland, the direct result of matrix dual authority is organizational volatility. "The person who reports to two bosses has to deal with two sets of expectations, two personalities, and two kinds of impact on his own priorities" (6:31). Working within a matrix management structure, an individual's work environment is filled with conflicting job-related tasking, one from the program manager and one from his functional supervisor (4:11). An action to fulfill one boss's needs may result in confrontation with the other boss.

A matrix organization may be as simple as a single project unit supported by the functional units, as displayed in Figure 4. Alternatively, the organization may be moderately complex, having many project units to be supported by the functional units (Figure 5). Or, the matrix structure may be extremely complex, as illustrated in Figure 6. As matrix organizational structure complexity increases, the associated problems of organizational authority, role definition and delegation of responsibility increase proportionately.

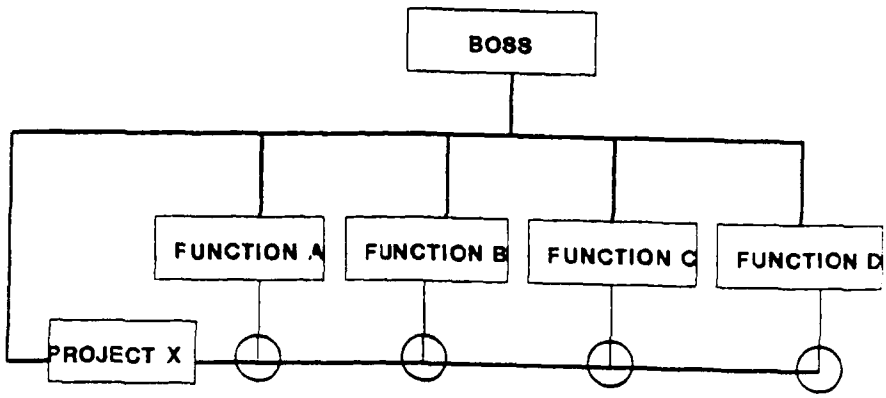

Figure 4. Single Project Matrix Structure

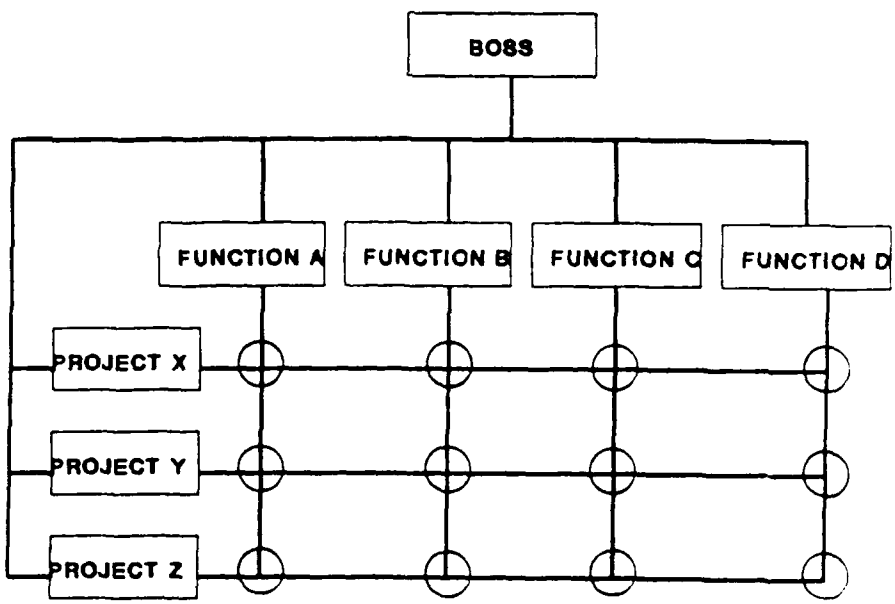

Figure 5. Multiple Projects Matrix Structure

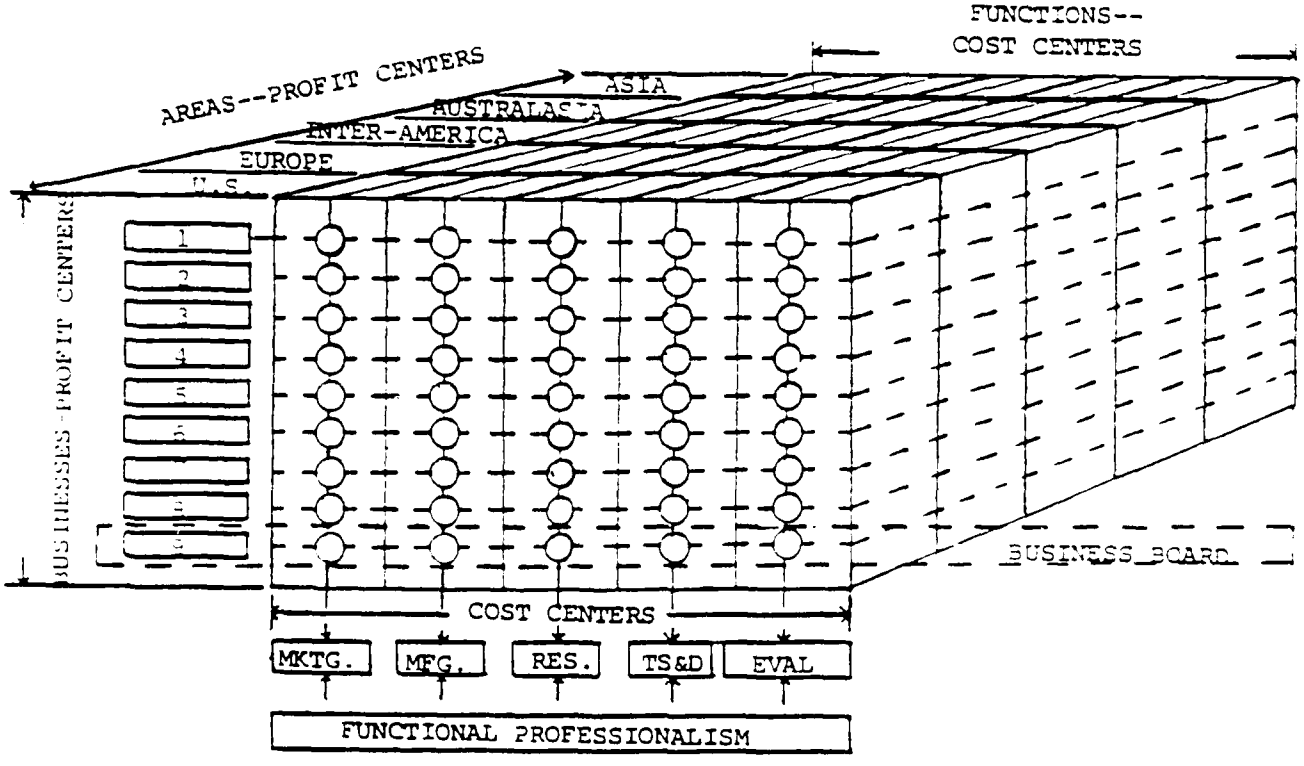

Figure 6. Dow Corning--Multidimensional Structures (11:60)

Matrix Structuring Characteristics. In theory, the matrix organization should optimally possess the positive organizational advantages of both previously discussed structures (functional and project), without the negative attributes of either. In application, however, conflict and communication problems are associated with the matrix organization (7,29).

Matrixing Goals. The three goals of matrix structuring, according to Davis and Lawrence, are:

(1) The focusing of undivided human effort on two (or more) essential organizational tasks simultaneously;
(2) the processing of a great deal of information by people and the commitment of the organization to a balanced, reasoned response (a general manager response), and;
(3) the rapid redeployment of human resources to various projects, products, services, clients, or markets [8:21].

Following definition of project goals, the matrix-structured organization must incorporate these goals into the overall business strategy. How these goals are incorporated into the business strategy and ultimately how the organization is structured depends on the complexity of the company's business and the uncertainty of its environment (19:89,8:70,15:37-38,22:5). Within the Aeronautical Systems Division, goal incorporation and organization structuring are established by the commander. A representation of the strategy to meet defined objectives is shown in Figure 7. This figure reflects the commander's perception of the

appropriately tailored matrix structure which will efficiently and effectively achieve business objectives. The commander does have the authority to dynamically change this structure if necessary. Figure 7 diagrammatically represents the current ASD functional deputies: program control (AC), engineering (EN), logistics (AL), and contracts (PM). Each functional deputy is central to the matrix organization and physically transfers functional experts to the system program offices. Within each of the three system program offices examined in this research (ASD/AE, ASD/RW, and ASD/YW), a secondary matrix structure is employed (Figure 8). The secondary matrix structure is organized with appropriate functional disciplines and personnel supporting specialized system program offices. In most cases, all functional personnel work together in one office to support program managers in other physical locations.

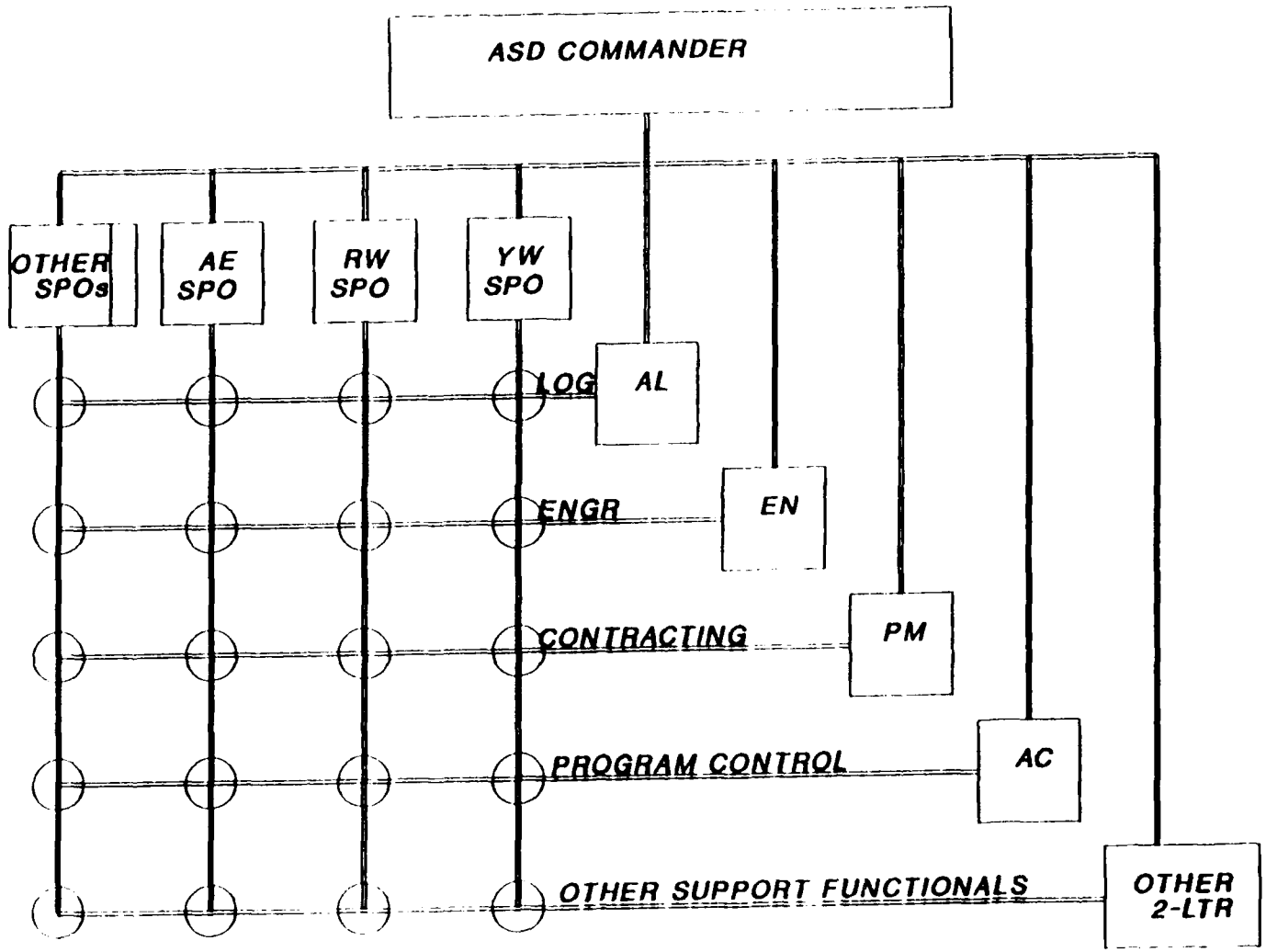

Figure 7. Aeronautical Systems Division Structure (1)

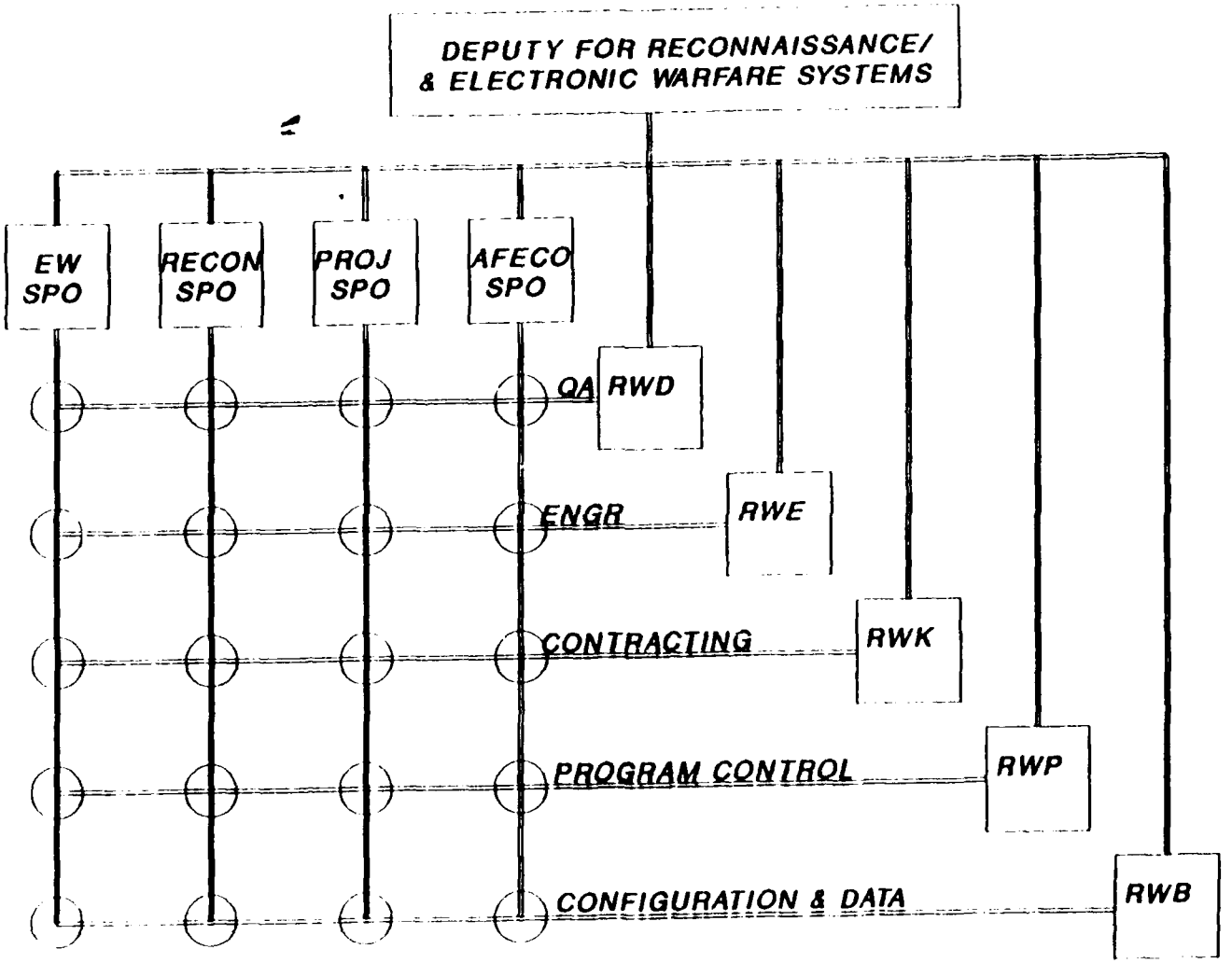

Figure 8. Reconnaissance/Electronic Warfare Program Office Organizational Chart

Matrix Structure Assets. The advantages of a matrix organization are the combined strengths of both the functional and project organizational structures, plus the flexibility inherent to the matrix concept (2:41,28:22). According to Baber, "This (looseness) implies emphasis on narrowly defined duties, promoting freer communication, and reducing both stratification and sectionalism by placing greater emphasis on group processes" (2:41). Davis further states:

> The matrix idea offers the potential of achieving the flexibility that is so often missing in conventional single-command organizations and reconciling this flexibility with the coordination and economics of scale that are the historic strengths of large organizations [8:70].

In application, flexibility functions to reduce traditional confining boundaries, thereby allowing less rigid role definition, greater productivity and greater perceived proficiency. Commenting on the effectiveness of applying the matrix concept, William Goggin, board chairman and chief executive officer of Dow Corning, states: "We perceive our [matrix] organization to be a dynamic one; and to date, our experience indicates that we do indeed have the ability to manage change rather than be managed by it (16:65).

Matrix Structure Liabilities. Conceptually, matrixing appears to be the optimum organizational management structure; however, the flexibility advantage may

also function as a liability, in that a trade-off is made between flexibility and role standardization. The result of this exchange is role ambiguity. Total role ambiguity is a condition in which employees have no clear understanding of their function in a particular organization (20:167). A characteristic of role ambiguity in the matrix organization is that employees have overlapping and unclear responsibilities. Thus an employee has no knowledge of when, or if, his part of the task is completed (35:73). This research effort will determine whether such overlapping or ambiguous responsibilities (role ambiguity) between configuration and data managers and program managers are present within the three ASD organizations examined.

The relationship between role ambiguity and matrix flexibility is expounded upon by Joyce:

> Because projects end and new ones begin, a recurring process of change is inherent in matrix structures. Adopting a matrix structure also increases role ambiguity. In such arrangements, responsibility for task execution rests with both lateral and hierarchical managers making explicit definitions of their respective responsibilities difficult [19:539].

In an effort to counter the role ambiguity factor, Murray advocates that all matrix organizations should maintain a conducive environment in which roles are clearly defined and understood (26:251,5:19). Although Murray's recommendation contradicts the flexibility premise of a matrix organization, executing such a recommendation may be

necessary in order to maintain some degree of consistency in role definition. Studies by Kerr, Jermier, and House have shown that increased organizational formalization reduces role ambiguity (27:822). Adding further corroboration, Podsakoff states: "One possible reason for the negative relationship between organizational formalization and role conflict that we found is that organizational formalization may add clarity to jobs" (27:826). The Aeronautical Systems Division does establish some basic organizational formalization in application of the matrix concept. This formalization is discussed on the next page in the section of this thesis titled, Air Force Matrix Application.

History of Matrix Structuring

Matrix structuring was first applied in the 1960's in an attempt to resolve inadequacies which had become evident in project and functional structuring. According to Donald Kingdom, formerly of TRW Systems, the concept of a matrix organization was created for government contracts (21:1). Kingdom viewed matrix structuring as:

> a compromise between two sets of needs: the customer's need for unified direction of the project to avoid having to negotiate with a series of separate functional managers, and the company's need for continuity as a viable, developing organization building up its capability to handle future projects as well as current ones through the existence of strong specialist departments [20:1].

From the 1960's to the present, the matrix management concept has been utilized in all facets of the industrial environment. Application of this management concept was directed towards creating an organizational structure which would allow efficient and effective accomplishment of the overall objective.

The organizational policies of the Department of Defense do not correspond with the overall concept of matrix organizations. The Air Force's long-standing policy of creating organizational structures with centralized control and functional groupings complicates the complete [unrestricted] application of the matrix concept (11,17). Exceptions to the Air Force policy are permitted, however, which allow organizations ". . .to keep pace with technological advances, changing missions, and concepts of operation; [and] . . .to streamline the decision-making process. . ." (17:11). Therefore, owing to the "exceptions" regulation, the Aeronautical Systems Division (ASD) is permitted to apply the matrix management concept.

Air Force Matrix Application

As stated previously, the structure of an organization must complement the business environment. Currently, most Air Force weapon systems produced are considered highly technical and complex. This technical complexity has forced the Aeronautical Systems Division to adopt a matrix

organizational structure. ASD Regulation 30-2 governs the matrixing of personnel within ASD, in that it establishes the degree of organizational formalization which all organizations must obey (12:1). This regulation represents the only direction imposed by the ASD commander. Individual organizations (system program office) may also establish additional formalization guidelines. However, any additional organizational formalization guidance must be consistent with the ASD regulation.

ASD Matrix Functional Utilization. A key concept of matrix management theory is the premise that all the functional support will be balanced (8:21). In the acquisition environment, if the program manager does not fully utilize supporting personnel, then he may not be perceived to be as competent as (and probably won't be as successful as) the program manager who recognizes specialized competencies and subsequently uses all supporting functional personnel. Functional utilization is determined by two factors: by the program manager's perception and judgement (knowledge of function) of the functional and by the program manager's clear assignment of the functional's roles and responsibilities. If the functional is perceived as lacking competence or if unclear role assignments (role ambiguity) lead to ineffective task accomplishment, the utilization of the particular functional

will be noticeably diminished (35). Whether or not a program manager utilizes a functional member remains the program manager's choice.

Measurement of Competence

The effectiveness of a program manager depends upon the competencies of functional personnel and the degree to which the manager utilizes this competence. Determining the competence of any given individual within any professional area is difficult, if not impossible. Both subjective and objective factors are involved in the determination of competence. In 1975, Wagner and Morse developed a practical instrument for measurement of an individual's competence for further research dealing with a sense of competence. The results of the Wagner and Morse effort was a twenty-three item questionnaire. Questions were divided into four major categories of factors. The first factor was designated "Competence Thema". This factor characterizes the individual's overall global feeling of a sense of competence. The second factor, designated "Task Knowledge/Problem Solving", measures the ability of the respondent to understand and solve problems encountered in the work environment. Factor three, "Influence", measures an individual's predisposition toward internal, versus external, control in making job-related decisions. The final factor, that of "Confidence", measures the

respondent's own trust and faith in oneself, which is an essential part of a person's sense of competence (34).

The reliability obtainable from the Wagner and Morse questionnaire had a coefficient of 0.96 (Kuder-Richardson method) on the test/re-test group (34:458). Reliability is a measure of how accurate, on the average, the estimated scores of an instrument are. Reliability may range from 0.00 (all error is attributable to measurement), to 1.00 (no error is due to measurement). A reliability coefficient of 0.60 or greater is considered acceptable for repeatability.

In an attempt to verify the 23-item questionnaire of Wagner and Morse, Synder and Morris conducted research on the four designated competence factors. Synder and Morris determined that three of the four established factors provided the same determination or measurement of competence. Therefore, the 23-item questionnaire was reduced to 15-items. Competence categories were redesignated as sense of competence, influence, and task knowledge. The reliability coefficient obtainable from the Synder and Morris study was similar to that obtainable using the Wagner and Morse questionnaire (30).

In 1985, Lieutenant Wilson used the Wagner and Morse questionnaire to measure the sense of competence of Air Force junior officers employed in civil engineering. Tailoring the survey instrument, Lieutenant Wilson surveyed the junior officers and respective supervisors on the junior officers' sense of competence. The reliability coefficient of Lieutenant Wilson's effort was 0.85 (36).

In 1987, Captain Miller also used a tailored version of the Wagner and Morse questionnaire to measure the sense of technical competence among Air Force senior officers possessing the Air Force Specialty Code of 2916. Captain Miller used the matched-pair methodology approach, gathering data from the individual Air Force officers and from their respective matched technical advisors (program engineers). The reliability coefficient of Captain Miller's measurement device (0.82) reconfirmed the excellent repeatability of the Wagner and Morse questionnaire (24:53-55).

A tailored modification of the Wagner and Morse questionnaire will be employed for data collection for this research, since it involves the complex factors of competence determination, and since the results need to be reliable. This methodology is the most reliable means of data collection presently available. Likewise, a modification of the Miller approach will be followed to utilize program managers to corroborate configuration and data managers competence ratings.

III. Methodology

Introduction

This project was tailored to study the degree to which individual configuration and data managers specialized competence is utilized by program managers within an ASD matrix organization, and how such utilization relates to the total productivity of the three configuration and data management divisions surveyed. The design of this study required the employment of personally administered competence questionnaires for data collection. Analysis of data was accomplished by utilizing one-way analysis of variances and Pearson r correlations.

Justification

A survey approach, specifically the personal interview technique, was chosen as a data collection device for this research project. Other techniques, including experimentation and direct observation/objective measurement of specialized competence were deemed inappropriate due to an inability to control actions and responses of human subjects and due to the time limitation imposed by the AFIT program.

Surveying, which measures an individual's perception and opinions regarding a specific topic may be of two types, mail surveys and personal interviews. In order to effectively address the research question posed in this

project, personal interviews were chosen over mail surveys. The personal interview facilitates data collection in that the potential misunderstanding of terms and constructs used is avoided. The personal interview is a "face-to-face", two-way conversation, initiated by an interviewer for the purpose of obtaining information from a respondent (14:160). The greatest advantage of this data collection technique is the precise nature of information that can be attained. Information collected by interviewing surpasses that collected by the mail survey in that the researcher can instantaneously improve question quality by language modification, concept/question clarification and by changing the questioning format. Additionally, validity is ensured since ratings by program managers can easily be matched with respective self-rating of the configuration and data managers.

Disadvantages of the personal interview technique include time expenditure of both the interviewer and the respondent, errors resulting from inappropriate statement of the question, and errors in response transcription by the interviewer. Most damaging to the validity of the personal interview technique is the contribution of inaccurate information by the respondent. A falsification or inaccurate presentation of information may substantially decrease validity of data and subsequent recommendations

(14:160). However, as stated in chapter one. this research assumes that all information is true and correct.

Construction of the Data Collection (Measurement) Devices

To ensure that information pertaining to this research project was gathered in a thorough and systematic manner, the following procedures were used to construct of the questionnaire and establish the format of the personal interviews.

a. Reviewed the literature relevant to the elements of this research problem. To provide a foundation, performed a literature review summarizing related, previously conducted studies and conclusions. Data collection techniques were assessed and evaluated with respect to this research problem.

b. Constructed a preliminary questionnaire based on the proven reliability of Captain Miller's adaptation of the Wagner and Morse questionnaire.

c. Requested a critical review of the preliminary questionnaire by an individual knowledgeable in this field (independent of this research project).

d. Revised data collection instruments for enhanced effectiveness.

e. Tested the revised survey and interview questionnaire for data appropriateness and question applicability using a panel of experts from the research field.

f. Revised survey and interview questions using recommendations provided by the expert panel.

g. Provided a copy of the interview questionnaire to the commanders of participating organizations to obtain their approval of the use of the survey in their organization.

h. Collected information and performed data analysis.

Scope of the Study

The population of interest includes configuration and data personnel and respective program managers (matched pairs) serving in System Program Offices (SPO) which utilize a matrix management structure for the management of individually directed programs. The cross-sectional survey encompassed, and was administered to, the following Aeronautical Systems Division organizations: ASD/YW, ASD/RW, and ASD/AE. Within those three organizations, a sample size of 27 of the 29 configuration and data managers was determined to be necessary to obtain a high level of external validity (10). Since each configuration and data manager supports several program managers, a convenience sampling technique was employed in selecting the program manager pairings.

Discussion of the Questionnaire.

This research project utilized the framework of Captain Miller's interview questions with modifications to obtain information on characteristics unique to the configuration

and data manager. The questionnaire employed for this study provides a measure of the level of perceived competence of the configuration and data manager. Perceived competence is determined by arithmetic summation of the rating values for the unique characteristics of the configuration and data management function. In order to gather information pertaining to the unique aspects of the configuration and data management area, the questionnaire provides a means for evaluation of roles and non-designated managerial responsibilities.

The following paragraphs provide an explanation of each of the variables used in this research effort. Questions used for the configuration and data manager's portion of the interview are found in Appendix B. Program manager's questions used for this research project are located in Appendix D.

Configuration and Data Manager's Academic Level. Question 1 of the configuration and data manager's survey addressed education. The academic level of the configuration and data manager was based either on the level of actual formal educational completed or on enrollment in the advanced academic education. For example, if an individual possessed a high school diploma and was pursuing an associates degree, the individual was assigned the educational status of an associate.

Program Acquisition Phase. Question 2.1 of the configuration and data manager's survey (Appendix B), identified the program's acquisition phase. The program acquisition phase was computed from the program's milestone approval as described in detail in DoD Directive 5000.1 and DoD Instruction 5000.2.

Perceived Configuration and Data Manager's Competence. The competence variable was derived by the arithmetic summation of five independent areas cited in questions 3.1 through 3.5 of the configuration and data manager's survey and in questions 1.1 through 1.5 of the program manager's survey. Each question was given equal weight in the determination of the competence variable. Questions 3.2 - 3.5 and 1.2 - 1.5 of this project were essentially identical to those of Miller. However, since questions 3.1 and 1.1 explored the critical specialty areas of the configuration and data manager, an expansion (delineation of important subtopics) of the survey framework used by Miller was required to thoroughly evaluate the level of perceived competence given the breadth of responsibilities of the configuration and data manager. Questions 3.1.a through 3.1.g of the configuration and data manager's survey and questions 1.1.a through 1.1.g of the program manager's survey addressed unique tasks and issues relating to configuration and data management. Configuration and data

managers and program managers were asked to rate their abilities in performing specific duties. They were also asked to identify which duties were solely configuration and data manager responsibilities, which were solely program manager responsibilities, and which were shared.

Configuration and Data Manager's Utilization. Question 3.8 of the configuration and data manager's survey, and question 1.8 of the program manager's survey, addressed the degree to which the program manager utilized the specialized skills of the configuration and data manager.

Configuration and Data Manager's Intrinsic Aptitude. Questions 4.1 and 4.2 of the configuration and data manager's survey, and questions 2.1 and 2.2 of the program manager's survey, addressed intrinsic (self-perceived), and extrinsic (program manager-perceived) aptitude, respectively, to determine the individual's aptitude as an indicator of competence. These questions were similar to those used by Captain Miller to evaluate aptitude. The arithmetic summation of these two equally weighted questions constituted the aptitude variable.

Configuration and Data Management Importance. Questions 5.1 and 5.2 of the configuration and data manager's survey, as well as questions 3.1 and 3.2 of the program manager's survey, addressed the importance of configuration and data management. The importance of possessing a high level of

configuration and data management competence, as it relates to program acquisition phase, may provide an indication of when the configuration and data manager's involvement with the program development should occur. These questions were adapted from Captain Miller's survey which addressed a similar variable. The arithmetic summation of these two equally-weighted questions constituted the "importance" variable.

Other Information. Questions 6.1 through 6.3 of the configuration and data manager's survey and questions 4.1 through 4.3 of the program manager's survey explored various subjects directly related to configuration and data management and to program management. Configuration and data managers and respective program managers were asked to comment on key areas including training needs and deficiencies, the background of the configuration and data manager, and the areas of expertise possessed by a good configuration and data manager were examined. Analysis of these comments consisted of numerical tabulation and frequency distribution. The comments were compiled and serve as individual opinions of the attributes and qualities deemed necessary in a proficient configuration and data manager (Appendix G).

Data Analysis

The following sections describe the data analysis methods used to collect and analyze data obtained in support of this research project.

Description of Research Questions

Research Question 1. Is the perceived specialized competence of the configuration and data manager related to his/her type of academic education?

Statement of Hypothesis. Specialized competence ratings of configuration and data managers does not vary significantly and are not dependent upon the educational background of the manager.

This research question proposes that a relationship exists between the type of academic educational degree obtained and the configuration and data manager's intrinsic rating and the program manager's perceived rating of specialized competence. Both an independent and dependent variable are involved in analysis of this hypothesis. The independent variable was the configuration and data's manager's academic background. This variable was treated as a categorical variable. Academic degrees were placed into five categories. Separation of categories was based solely on relevant course curriculum required for degree completion.

The categories were:

1. Post-Bachelors Degree.
2. Bachelors Degree-Technical.
3. Bachelors Degree-Non-Technical.
4. Associate Degree.
5. High School Diploma.

The dependent variables in the analysis of the first research hypothesis is the configuration and data manager's self-perceived (intrinsic) and program manager's perceived (extrinsic) level of the configuration and data manager's specialized competence. These intrinsic and extrinsic specialized competence variables were measured using a subset from the Wagner and Morse competence questionnaire (questions 3.1 - 3.5 of the configuration and data managers' survey and questions 1.1 - 1.5 of the program managers' survey). The five subset items were modified for specific application to configuration and data management specialized competence. The scores for the five items were summed and averaged to compute a composite variable, which constituted the dependent variable (competence rating).

Data Analysis. Unbalanced single-factor analysis of variance (ANOVA) (alpha level = 0.05) was used to determine if a significant difference exists between values of the dependent variables. The ANOVA test allows determination of significant differences between categories. An ANOVA test

is the calculation of the squared within-sample variation divided by the squared between-sample variation. The resulting value may be converted into a numeric probability. The alpha probability level of 0.05 was used throughout this research project as the criteria of acceptability. Using an alpha level of 0.05, if the resulting probability (after the ANOVA calculations) of two sample populations is 0.05 or less, then the populations are considered to be significantly different from each other. The ANOVA test was performed both for the configuration and data managers' self-perceived (intrinsic) competence ratings and for the program managers' extrinsic competence ratings.

Research Question 2. Is the perceived specialized competence of the configuration and data manager related to their intrinsic aptitude?

Statement of Hypothesis. Extrinsic and intrinsic performance ratings of a configuration and data managers specialized competence are positively correlated with respective ratings of aptitude.

This research question addresses the relationship between the configuration and data manager's aptitude and their specialized competence, both as stated by the configuration and data manager and as perceived by the program manager. The independent variable is the perceived aptitude of the

configuration and data manager. Aptitude was determined by responses to questions 4.1 and 4.2 and questions 2.1 and 2.2 of the configuration and data manager's and program manager's survey, respectively. For the purpose of this study, the construct of aptitude included the following characteristics:

1. Configuration and data manager's propensity to ask questions pertaining to ambiguous aspects of the program.

2. Configuration and data manager's quickness in assimilating new program information.

The dependent variable, specialized competence, was measured and treated as described in Research Question 1.

Data Analysis. Two sets of data analyses were performed. One analysis addressed the intrinsic, or self-rating, of the configuration and data manager's aptitude and the specialized competence. The second data analysis performed addressed the extrinsic rating of the configuration and data manager's aptitude and the specialized competence as perceived by the program manager. A correlation analysis was performed to determine the Pearson r correlation coefficient representing the degree of correlation between the configuration and data managers' specialized competence and their specialized aptitude. The Pearson r correlation ranges in value from -1.00 to +1.00. A correlation coefficient of r = +1.00 signifies a perfect linear

relationship. As applied to this research, a correlation coefficient of +1.00 would indicate that aptitude directly improves competence. Likewise, a correlation coefficient of r = -1.00 indicates a perfect negative or inverse relationship between the two variables or, restated, that aptitude decreases competence. A correlation coefficient of r = 0.00 suggests there is no relationship between the respective values of the two variables. The correlation coefficient r is calculated by summing the differences between the means and the standard deviation of paired values of specialized competence and specialized aptitude divided by the sample size minus one (degrees of freedom).

Research Question 3. Is the perceived importance of the configuration and data manager's specialized competence related to the specific acquisition phase of the program?

Statement of Hypothesis. The perceived importance of proficient specialized competence ratings (extrinsic and intrinsic) of a configuration and data manager differs significantly with the system program phase.

Research question three addresses how critical or important the specialized competence of the configuration and data manager is during various system program phases. The independent variable is the program phase. Program phase was determined by the configuration and data managers'

response to question 2.1 of their survey. This variable was treated as a categorical variable with the following program phase categories:

1. Concept definition
2. Demonstration and Validation
3. Full-Scale Development
4. Production and Deployment
5. Operations and Support

If the phase variable was not definable, due to concurrent program phases, the configuration and data manager preferentially defined the phase as that which posed the most important program issues. The dependent variable is the perceived importance of the proficiency level of the configuration and data manager's specialized competence.

Data Analysis. An unbalanced, single-factor analysis of variance (ANOVA) (alpha level = 0.05) was used to determine significant differences between dependent variables. Results of the ANOVA test allow determination of significant differences existing between program phases. Testing was performed twice; once using the configuration and data manager's self-ratings and once using the program manager's extrinsic ratings.

Research Question 4. Is the perceived specialized competence of the configuration and data manager related to the degree of the program manager's utilization of this specialized competence?

Statement of Hypothesis. A positive correlation exists between the overall performance rating of a configuration and data manager's specialized competence and the program manager's utilization of that specialized competence for accomplishing program objectives.

Research question four addresses the relationship between the configuration and data manager's specialized competence rating and the degree to which the program manager utilizes and relies upon this specialized competence. The dependent variable is the perceived specialized competence of the configuration and data manager (determined for research question one). The independent variable is utilization of the configuration and data manager's specialized competence by the program manager. Utilization was determined by responses to question 3.8 and question 1.8 of the configuration and data manager's and program manager's survey, respectively.

Data Analysis. Correlation analysis was performed using the Pearson r correlation coefficient for the configuration and data manager's specialized competence and degree of

utilization. The correlation analysis was performed twice; once for the program manager's extrinsic utilization ratings of the configuration and data manager's specialized competence, and once for the intrinsic configuration and data managers utilization of specialized competence rating.

Research Question 5. Does the perceived specialized competence of the configuration and data manager differ significantly among ASD organizations?

Statement of Hypothesis. The overall performance rating of a configuration and data manager's competence does not vary among ASD organizations. Such lack of variation may be attributed to the consistency of written internal polices of a given organization.

Research question five addresses the relationship between a configuration and data managers specialized competence ratings (intrinsic and extrinsic) and the internal policies of the organization subunits. Central to this research question is the formalization of organizational policies relating to these specialized functions. Formalization, as noted in chapter 2 of this research, reduces the role ambiguity factor. The dependent variable is the configuration and data manager's perceived specialized competence. The independent variable is the configuration and data manager's responsible organization. This variable

was treated as a categorical variable with one category for each of the three organizations surveyed.

Data Analysis. An unbalanced single-factor analysis of variance (ANOVA) (alpha level = 0.05) was used to determine if a significant difference in competence ratings exists between the three organizations surveyed. Results of the ANOVA test will highlight any significant differences in recognition of specialized competence between organizations which may be attributed to formalized organizational policies. Testing will be performed twice; once using the configuration and data manager's intrinsic ratings, and once using the program manager's extrinsic ratings of the configuration and data manager's specialized competence.

Other Information

The survey instrument (questions 6.1 - 6.3 of the configuration and data manager survey and 4.1 - 4.3 of the program manager survey) addressed subject matter directly applicable to configuration and data management as well as the essential attributes or qualities identified with proficient configuration and data managers. Information gathered from configuration and data managers and program managers was used to determine which configuration and data manager's roles or individual attributes were key indicators of high competence levels. Data analysis conducted was a simple numerical tabulation of the configuration and data manager's and program manager's responses.

Reliability and Convergent Validity

In order to promote and subsequently assess the reliability and validity of this research effort, the following criteria were addressed.

Sample Size. For this research project, a survey interview sample size sufficient to achieve a 95 percent (+/- 5 percent) confidence level was determined to be appropriate for achieving a statistically sound representation of the population (10). Based on a finite population of 29 total configuration and data managers in three organizations, the sample size was determined to be 27.

Measurement Reliability. The determination of a numeric value of many hypothesis variables (e.g., intrinsic competence rating) was based the average of at least two survey instruments items. Cronbach alpha reliability coefficients were computed for each of these composite variables as an indication of the measurement reliability of the instruments. The Cronbach alpha reliability coefficient is designed for situations where the goal is to assess the reliability of a sum, or weighted sum, as an estimate of a variable (e.g., questions 3.1 - 3.5 and intrinsic competence ratings).

Convergent Validity. Convergent validity is a measure of how thoroughly independent instruments measure the same construct, or restated, of how similarly separate groups view the same phenomenon. In order to maximize the convergent validity for this research effort, the configuration and data manager, and the respective program manager, received survey instruments which contained identical items for measuring opinion/perception variables. To determine if there was a significant difference between the self-perceived (intrinsic) ratings and other-perceived (extrinsic) ratings of all variables, paired t-tests were conducted. The paired t-test indicates if the means of two groups are different, where the samples were drawn in pairs. The test is actually evaluating whether the mean of the differences of the pairs is different from zero. If the means were significantly different, one could draw the inference that the questionnaire was biased towards one of the groups.

Summary

A convenience sampling technique was employed in collecting data from configuration and data managers and respective program managers. The method of data collection employed was the survey, specifically that of the personal interview. Five hypotheses, related directly to research questions posed, were tested for validity by various

statistical analyses. Subsequent statistical analyses were performed to indicate both the level of measurement reliability of the instrument employed and the degree of convergent validity on key constructs.

IV. Results and Findings

Introduction

A total of 27 matched-pair interviews were conducted as a means of data collection to satisfy the goals of this research problem. The number of interviews conducted constitutes 93% of the total configuration and data management population in the three organizations surveyed. Subsequent statistical analyses were performed as described in chapter III.

This chapter present a discussion of significant findings (both qualitative and quantitative) related to the five research hypotheses posed by this project, as well as other findings relative to this research effort. An assessment of the validity and reliability of the survey used for data collection concludes this chapter.

Tests of Hypotheses

Each of the five hypotheses is discussed in the following format: statement of the hypothesis, statistical analysis, and qualitative inferences.

Hypothesis 1. Specialized competence ratings of configuration and data managers does not vary significantly and are not dependent upon the educational background of the manager.

Statistical Results. An unbalanced single-factor analysis of variance (ANOVA) (alpha level = 0.05) was used to determine significant differences between the educational background of configuration and data managers and perceived competence. Tables I and II represent summaries of ANOVA testing for the intrinsic and extrinsic ratings, respectively. Appendix F provides the raw data of the configuration and data manager's educational categories and competence ratings (intrinsic and extrinsic) obtained through the survey.

Table I. Bonferroni Multicomparison of Configuration Data Managers by Academic Degree (Intrinsic)

ANALYSIS OF VARIANCE PROCEDURE

BONFERRONI (DUNN) T TESTS FOR VARIABLE: COMPETENCE

ACADEMIC EDUCATION COMPARISON (CATEGORY)	LOWER CONFIDENCE LIMIT	DIFFERENCE BETWEEN MEANS	UPPER CONFIDENCE LIMIT	
(B) TECHNICAL/ (D) ASSOCIATE	0.024	3.681	7.337	***
(B) TECHNICAL/ (E) HIGH SCHOOL	3.398	6.856	10.313	***
(D) ASSOCIATE/ (E) HIGH SCHOOL	-0.395	3.175	6.745	

*** SIGNIFICANT DIFFERENCE BETWEEN MEAN AT ALPHA = 0.05

ALPHA=0.05 CONFIDENCE=0.95 DF=24

NOTE: THIS TEST CONTROLS THE TYPE I EXPERIMENTWISE ERROR RATE BUT GENERALLY HAS A HIGHER TYPE II ERROR RATE THAN TUKEY'S. CRITICAL VALUE OF T=2.57364

The Bonferroni t test was used to compare the competence rating of configuration and data managers within different education categories. Prior to a discussion of statistical analysis, terms associated with the Bonferroni t test must be defined.

In determining if the differences between educational categories are significant (ANOVA analysis), two types of errors may be committed. These errors, type I and type II, are based on the relationship between the hypothesis and the decision made following statistical analysis. In each case, statistical analysis begins with the statement of a null hypothesis. Type I errors occur when the null hypothesis is rejected, when the proposed hypothesis is true. For this project, stating that one education level and the related competence ratings differ significantly from the other levels when in fact there is no significant difference between levels, would constitute a type I error. A type II error occurs when the null hypothesis is accepted when the hypothesis posed should be rejected. Designating the alpha level of significance to be 0.05 decreases the possibility of a type I error occurring. The smaller the type I error (alpha), the less likely it is that a deviant sample response will cause the null hypothesis to be rejected. In testing the data, a critical value (T=2.5734), or test statistics value, is calculated from the degrees of freedom

(number of samples taken minus the number of different categories or 24) and the designated alpha level (0.05). If the comparisons of variances of the two categories is greater than the critical "T value", the resultant associated probability will be less than the alpha level (0.05), and it can be concluded that the two categories being compared are significantly different. By setting a range or, statistically speaking, a confidence interval (or limit) of 95%, conclusions can be inferred regarding the relationship of the variable with great accuracy. In Table I, the upper and lower confidence limits (reflecting the highest and lowest expected competence rating for an interviewee with a certain education) bound the range of numerical values into which the difference between the competence ratings of two individuals with the noted educational backgrounds would be expected to fall.

Information describing the relationship between educational background and perceived competence levels is shown in table I. Categories A (beyond technical degree) and C (non-technical degree) were not included in the statistical analysis of this project since none of the configuration and data managers interviewed possessed these educational backgrounds. The self-professed (intrinsic) educational category specialized competence rating means were: Technical Degree 31.56, Associates Degree 27.87, and

High School Diploma 24.70. Analysis of data indicated that configuration and data personnel within category B (technical degree) possessed the highest self-rated competencies (as shown by the greatest difference in means) relative to the other educational categories. This is reflected in the analysis of the variance in Table I. For example, when comparing configuration and data managers possessing a technical degree to those possessing a high school diploma, the manager possessing a technical degree can be expected to exhibit a competence rating ranging from 3.398 to 10.313 points higher (with 6.586 points being the average) than the manager possessing a high school diploma.

When the technical degree (B) was compared to the associates degree (D) and subsequently to the high school diploma (E), the resulting probabilities that the competence would be the same for both between the educational categories were 0.0097 and 0.0001, respectively. Both calculated probabilities fall below the designated 0.05 alpha level, making the groups (B:D, B:E) significantly different. A statistically significant difference did not exist however between the associates degree (D) and the high school diploma (E), where the probability was calculated to be 0.0523. A calculated probability greater than the alpha level indicates that no difference in competence exists between the educational categories of associates degree and

high school diploma. However, since the probability was very close to being statistically significant, it can be inferred that additional education appeared to have some influence upon intrinsic competence ratings.

Results of data analysis presented in Table II extrinsic (program managers perceived) competence ratings indicate a similar trend in the education/competency relationship to those obtained for the intrinsic (configuration and data manager's self perceived) competence ratings. The educational category specialized competence (extrinsic) means were: Technical Degree 31.22, Associates Degree 27.75, and High School Diploma 23.10. Differences in extrinsic competency ratings between configuration and data functionals possessing a technical degree (B) and those possessing either an associate degree (D) or a high school diploma (E) were statistically significant (probabilities were 0.0083 and 0.0001, respectively). Similar to data analysis for self-rated competency, configuration and data personnel within category B (technical degree), possessed the highest extrinsically rated competencies relative to the other educational backgrounds.

In contrast to the intrinsic competency results, where no statistical difference was observed between categories D and E (associates degree versus high school diploma), the extrinsic competency ratings did yield a statistically

significant difference between categories (probability value = 0.0048). The program manager's ratings definitely equated that additional educational attainment with competence.

Table II. Bonferroni Multicomparison of Configuration Data Managers by Academic Degree (Extrinsic)

ANALYSIS OF VARIANCE PROCEDURE

BONFERRONI (DUNN) T TESTS FOR VARIABLE: COMPETENCE

ACADEMIC EDUCATION COMPARISON (CATEGORY)	LOWER CONFIDENCE LIMIT	DIFFERENCE BETWEEN MEANS	UPPER CONFIDENCE LIMIT	
(B) TECHNICAL/ (D) ASSOCIATE	0.346	3.472	6.598	***
(B) TECHNICAL/ (E) HIGH SCHOOL	5.166	8.122	11.078	***
(D) ASSOCIATE/ (E) HIGH SCHOOL	1.598	4.650	7.702	***

*** SIGNIFICANT DIFFERENCE BETWEEN MEAN AT ALPHA = 0.05

ALPHA=0.05 CONFIDENCE=0.95 DF=24

NOTE: THIS TEST CONTROLS THE TYPE I EXPERIMENTWISE ERROR RATE BUT GENERALLY HAS A HIGHER TYPE II ERROR RATE THAN TUKEY'S CRITICAL VALUE OF T=2.57364

Qualitative Inferences. Figure 9 presents a scatter plot of competency versus educational level. This plot was constructed from the configuration and data managers self-rated competence and program managers extrinsic rated competence data. It should be understood that although the results obtained do not necessarily attribute a high absolute degree of actual competency to a technical degree (educational category B), the results do attribute a higher relative degree of perceived competency to the technical degree. Even though this research project did not quantitatively determine specifically how possessing a technical degree affects job performance, it should be noted that the perception of competence of a configuration and data manager possessing a certain education is often more important than actual job performance. In general, the positive perception generated by the technical degree may result in the program manager having more confidence in, and perhaps utilizing to a greater extent, a configuration and data manager who possesses a technical degree than a manager who does not.

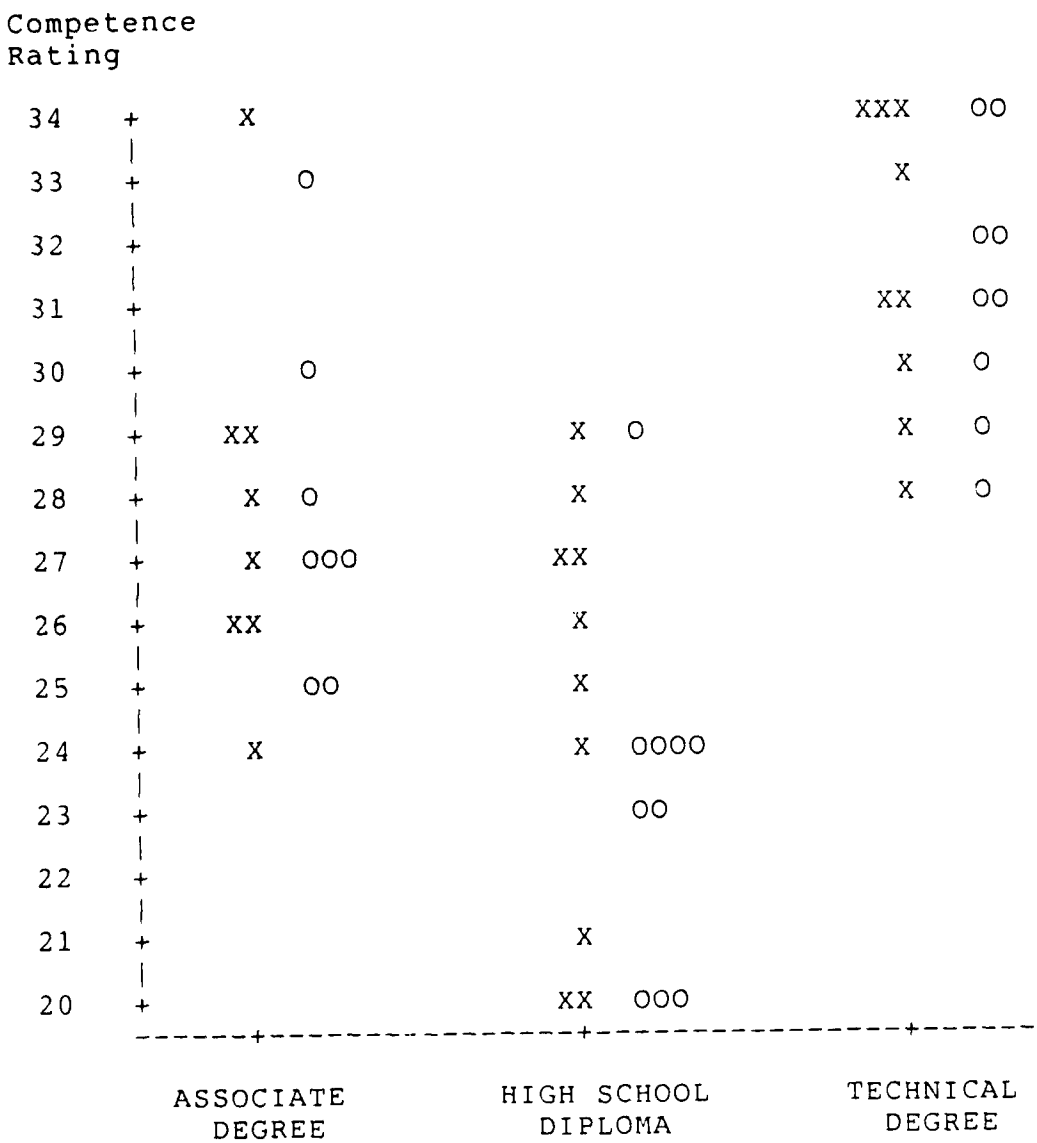

Figure 9 . Competence Ratings Versus Education Level

Hypothesis 2. Extrinsic and intrinsic performance ratings of a configuration and data managers specialized competence are positively correlated with respective ratings of aptitude.

Statistical Results. Correlation analyses between ratings of specialized competence and aptitude (ability to pursue unclear issues and assimilate new information) were performed using the Pearson r correlation coefficient. The first analysis examined the relationship between intrinsic aptitude and specialized competence of configuration and data managers. The second analysis examined the relationship between the extrinsic (program manager perceived) aptitude ratings of the configuration and data managers and extrinsic related specialized competence. For the intrinsic (self) ratings of aptitude versus specialized competence, correlation coefficients were of the magnitude of 0.8803. Similarly, for extrinsic ratings, the correlated relationship yielded a coefficient of 0.7953. Since 0.6 is considered good correlation and 0.8 is excellent, these values indicate that a high positive correlation between both intrinsic and extrinsic data sets exists.

Qualitative Inferences. A high positive correlation (for both intrinsic and extrinsic ratings) between the level of a configuration and data manager's competence and the level of aptitude indicates that aptitude is a very strong

predictor of competence. This strong positive correlation suggests that labeling an individual as competent or not competent, based solely upon the individual's academic degree, may not be appropriate. Rather, the individual's aptitude or ability to pursue unclear issues and assimilate new information would be at least equally as important as education in assessing the individual's level of competence.

Hypothesis 3. The perceived importance of proficient, specialized competence ratings (extrinsic and intrinsic) of a configuration and data manager differs significantly with the system program phase.

Statistical Results. This analysis was intended to determine if a significant difference exists among the ratings of the importance of specialized configuration and data management competence for various program phases. However, the statistical analyses were not performed since most of the configuration and data management acquisition programs were in one (full scale development) of the five phases. Since all five program phases were not represented, results of statistical analysis would be inconclusive due to the small sample size for the other program phases.

Qualitative Inferences. While interviewing configuration and data managers and respective program managers, both stated that configuration and data management issues were of greatest importance during the full scale development phase and the production phase. This perception supports the research findings of Thamhain, Miller and Baumgarter, who all found that the intensity of management conflicts associated with programmatic issues varies with the acquisition program phase and is most prevalent in full scale development and production (3,24,31).

Hypothesis 4. A positive correlation exists between the overall performance rating of a configuration and data manager's specialized competence and the program manager's utilization of the specialized competence for accomplishing program objectives.

Statistical Results. Correlation analyses between specialized competence and utilization of specialized competence by a program manager were performed using the Pearson r correlation coefficient. The correlation analyses were performed twice; once using intrinsic (self-perceived) ratings of specialized competence and utilization by respective program managers, and once using the extrinsic (program manager perceived) ratings of specialized competence and utilization by the program manager. The utilization of the configuration and data managers, as

related to intrinsic ratings of specialized competence yielded a correlation rating of -0.1322. A correlation value of essentially zero indicates that configuration and data managers believe that utilization of their specialized competence by a program manager is not related to self-rated competence. The program manager's (extrinsic) ratings of utilization as related to competence produced a correlation relationship of 0.4452. This correlation rating is marginal (0.6 is considered good) and indicates that utilization of specialized competence by the program manager is probably unrelated to specialized competence.

Qualitative Inferences. During the survey and interview process, program managers rated many of the configuration and data managers as possessing a certain degree (many with a high degree) of specialized competence. However, the marginal correlation rating (0.4452) indicates that a program manager's utilization of the configuration and data manager is not related to that perceived competence, even for the well-qualified configuration and data managers. In other words, greater competence does not mean greater utilization by the program manager. The competence rating of -0.1322 for configuration and data managers appears to confirm this. This is probably the most important finding of this project.

Discussions with configuration and data managers revealed a prevailing opinion that a configuration and data manager is utilized only in a "fire-fighting" mode. This crisis mode requires that the program manager utilize his functional personnel in order to attain instantaneous results to meet critical program deadlines. Outside of the crisis mode, however, configuration and data functionals are utilized at a minimum level. In interviews conducted with program managers concerning the utilization issue (and especially with managers who did not utilize configuration and data functionals), a majority stated that they were better able to perform the configuration and data manager's duties than was the configuration and data manager himself. The program managers partially justified this by saying that the time required to relay the tasks to the configuration and data manager was greater than the time required to accomplish the task. One program manager went so far as to create a self-sufficient data tracking system for the purpose of monitoring the contractor's data submissions independent of his configuration and data functional.

Hypothesis 5. The overall performance rating of a configuration and data manager's competence does not vary among ASD organizations. Such variation may be attributed to the internal polices of a given organization.

Statistical Results. An unbalanced single-factor analysis of variance (ANOVA) (alpha level = 0.05) was utilized in determining if significant differences exist between of the three sample group organizations. Performance of the ANOVA test between the three organizations indicated that no statistically significant difference in intrinsic or extrinsic competence rating existed between organizations. The organization competence means were intrinsically AE-28.62, RW-27.73, and YW-27.50 and extrinsically AE-27.25, RW-27.45, and YW-26.75. Supporting analysis results are presented in Table III. Comparison probabilities between organizational groupings were all calculated to be greater than the designated 0.05 alpha level.

Qualitative Inferences. The internal policies and operating procedures of the configuration and data management area have been detailed in the appropriate DoD and Air Force Regulations and military standards. The minor variations in internal organizational policies and procedures, for the organizations surveyed in this research project, did not have an apparent influence on the level of intrinsically or extrinsically perceived specialized competence of configuration and data managers. While policies among the three organizations are different, the differences exist primarily in the detailed execution of key

configuration and data management tasks. During questioning, however, configuration and data managers stated that actual task performance was frequently not in accordance with organizational policies due to of the program manager's management style. Such deviation from organizational policies for various programs serves to invalidate organizational formalization, thereby increasing role ambiguity, and, for the configuration and data manager, increasing the difficulty of attaining specialized competency.

Table III. Bonferroni Multicomparison of Configuration Data Managers by Organization

ANALYSIS OF VARIANCE PROCEDURE

BONFERRONI (DUNN) T TESTS FOR VARIABLE: COMPETENCE

INTRINSIC RATINGS

ORGANIZATIONAL COMPARISON	LOWER CONFIDENCE LIMIT	DIFFERENCE BETWEEN MEANS	UPPER CONFIDENCE LIMIT
AE - RW	-4.117	0.898	5.913
RW - YW	-4.788	0.227	5.242
YW - AE	-6.521	-1.125	4.271

ALPHA=0.05 CONFIDENCE=0.95 DF=24

EXTRINSIC RATINGS

ORGANIZATIONAL COMPARISON	LOWER CONFIDENCE LIMIT	DIFFERENCE BETWEEN MEANS	UPPER CONFIDENCE LIMIT
AE - RW	-5.531	-0.204	5.122
RW - YW	-5.372	0.204	5.531
YW - AE	-5.482	-0.250	5.982

ALPHA=0.05 CONFIDENCE=0.95 DF=24

*** SIGNIFICANT DIFFERENCE BETWEEN MEAN AT ALPHA = 0.05

NOTE: THIS TEST CONTROLS THE TYPE I EXPERIMENTWISE ERROR RATE BUT GENERALLY HAS A HIGHER TYPE II ERROR RATE THAN TUKEY'S. CRITICAL VALUE OF T=2.57364

Other Qualitative Findings

During the interviews, configuration and data managers emphasized the configuration and data management staff agency's (ASD/ENO-AWZ) inability to assert authority in both the administration and enforcement of practices and policies. Under the existing organizational structure, the configuration and data management office is subordinate to the functional Deputy for Engineering. All policies and practices to be implemented by the configuration and data management staff agency must be coordinated through, and approved by, the engineering deputy. The proposal for implementation of a particular policy to enhance configuration and data management by the staff agency may not be approved by the Deputy for Engineering if a conflict with engineering interest is foreseen. The intended purpose of the configuration and data management staff agency includes assuring the promulgation of good configuration and data management policies, monitoring program office implementation of configuration and data management policies, and advising and training program personnel in "correct" configuration and data management practices. The multipurpose nature of the staff agency coupled with the requirement to coordinate all activities through the functional Deputy for Engineering results in staff agency delays and (sometimes) less than optimal revisions to proposed actions.

During the interview process, questions concerning the delegation of duties associated with the configuration and data management area were asked of both configuration and data managers and program managers. The numeric summation of responses is located in Appendix G. A majority of the configuration and data managers currently perform their assigned duties as required by policy for the normal order of business of their programs. However, as previously mentioned, utilization of the configuration and data manager over and above these assigned duties (other than in special program situations) is minimal. The configuration and data managers and the program managers did agree on the duties which should be performed by the program manager and those which should be performed by the configuration and data manager. This breakout of responsibilities differs significantly from current practices and should be employed in the redefinition of the standard roles and responsibilities of the program manager and of the configuration and data manager.

When asked to identify the attributes and qualities possessed by a "proficient" configuration and data manager, no consensus was reached regarding the educational level among the configuration and data managers. Consensus was achieved in the areas of: experience (number of years), experience (in certain functional areas) and specialized

education (see Appendix G). The configuration and data managers (intrinsic) stated that a proficient manager (for multiple small programs in a matrixed situation) must have at least two years of configuration and data management experience. Further, a proficient manager is very familiar with the functional practices and concepts associated with engineering and logistics. With the goal of increasing productivity, the configuration and data managers expressed strong interest in the following educational areas: software documentation, engineering drawings regulations, system engineering application, and automated databases.

From the extrinsic viewpoint, desired attributes of a configuration and data manager were easily identified. Ideally, program managers very strongly desired a configuration and data manager possessing a technical degree with an understanding of the engineering functional area. Believing that increased productivity is achieved through education and supplemental training programs, the program managers duplicated the configuration and data manager's response with regard to educational interest areas.

Training/Education. An issue raised by a majority of the configuration and data managers interviewed was the subject of training as a means for enhanced job performance. Relevant training, timely training and on-going education were the specific concerns voiced by configuration and data

managers. All believed that their training and education were neglected to increase availability for work and that participation in training and education programs would serve to increase their effectiveness and their overall competence in the performance of their duties.

Relevant training coursework, designed to create an awareness and understanding of configuration and data management issues directly related to the duties of the functional, are offered by the Air Force Institute of Technology. Though courses are available in configuration, data, and engineering data management, configuration and data functionals concur that detail issues and subject material deemed important are not adequately addressed by the AFIT courses. Rather, a superficial "theory-oriented" approach is taken. Specifically, several configuration and data managers stated that the AFIT engineering data management course was a "complete waste of time and money" at the time they attended it; the instructor had no greater knowledge in the engineering drawing area than some of the attending students. And if AFIT is only providing the background, the ASD staff agency and program office On-The-Job training are not providing the additional details required for the configuration and data managers to adequately learn their assigned duties.

Timely consultations by directing specific questions to an expert in the configuration and data management area about situations as they arise is also an important concern. Ideally, within ASD, configuration and data management personnel receive official guidance from the staff agency (ASD/AWZ). However, a majority of the configuration and data personnel believe that staff agency guidance or support is not readily available. Needs of, and requests by, the program office configuration and data managers are not being adequately handled by the staff agency.

Continuing, or on-going, education, available through national and regional seminars and conferences would also be useful in enhancing the capabilities of the configuration and data manager. The configuration and data managers believe that a greater opportunity to attend and participate in configuration and data seminars would increase their productivity.

Significant Findings

During the data collection process, discussions with configuration and data managers for this project brought out several significant items. These findings are:

(1) The configuration and data manager is relatively insignificant when compared to other functional program personnel.

Interview responses by program managers and configuration and data managers (extrinsic and intrinsic, respectively) to questions 3.7 and 1.7 of their surveys and subsequent analyses of the responses, indicate a prevailing attitude that program managers consider the configuration and data manager "non-essential" to program success but that they consider the configuration and data management duties essential.

(2) In general, there are few sufficiently knowledgeable configuration and data management personnel.

Further complicating the image problem of the configuration and data manager is the fact that the configuration and data management workforce surveyed is currently comprised of a significant percentage (60%) of trainees, with few well-qualified individuals among the ranks. Trainees yet unfamiliar with many aspects of configuration and data management are assigned to acquisition programs as the only configuration and data management resource. Clearly, such trainees have great difficulty operating effectively under these circumstances. As stated previously, configuration and data managers felt that at least two years of experience was required to provide adequate expertise for these matrix positions.

(3) In general, the program manager possesses an inadequate understanding of the breadth of the configuration and data management and of the duties performed by a configuration and data manager.

The program manager does not help the configuration and data manager to gain the needed experience Many program managers have an incomplete understanding of configuration and data management issues, or of the functions the configuration and data manager should accomplish, and so do not know when or how to utilize the configuration and data manager. Ultimately, the outcome is <u>under-utilization</u> of the configuration and data manager and a lack of training situations to increase their competence.

(4) Utilization of a configuration and data manager is unrelated to the individual's competency level.

As noted in chapter two of this thesis (regarding the importance of competence), the program manager's lack of confidence in the abilities of the configuration and data manager, coupled with the physical non-availability of the configuration and data manager, may result in non-utilization of this functional. Configuration and data information and activities deemed necessary for program goal accomplishment were often processed and accomplished independent of the configuration and data functional. Far too often, the rationale used to make the utilization versus

non-utilization decision was based upon the program manager's own ability to comprehend configuration and data management issues, his opinion of the time required for the task completion and of the configuration and data manager's familiarity with program issues, and the ready availability of the configuration and data manager. Since most program managers opt to bypass the configuration and data managers, this can undermine the effectiveness of the entire acquisition process. Since the program manager is ultimately responsible for development of the new acquisition system, decisions pertaining to utilization or non-utilization of functional personnel are made at his discretion. Interview responses, from both program managers and configuration and data managers indicate that configuration and data managers are utilized far less frequently (other than in a crisis situation) than other functional program personnel. The analysis of the interview responses indicates that individual competencies of configuration and data managers, whether highly competent or trainee in nature, do not significantly influence the utilization or non-utilization of the configuration and data manager by a program manager.

Reliability and Convergent Validity

Measurement Reliability. Cronbach alpha reliability coefficients were calculated for the configuration and data manager survey instrument and for the program manager survey instrument. The reliability measured the accuracy, on the average, of the scores for the composite (summed and averaged) variables. Reliability may range from 0.00 (all error is attributable to measurement), to 1.00 (no error is due to measurement). The reliability coefficient for the five item specialized competence index was 0.75. A 0.82 Cronbach alpha was calculated for the two-item aptitude index. The two-item specialized importance index exhibited a 0.88 Cronbach alpha. Therefore, the composite variables can be deemed very reliable predictors in their areas.

Convergent Validity. Paired t-values were calculated to assess how closely the opinions of the configuration and data manager and his/her respective program manager matched. The paired t-test produced no significant differences between the intrinsic and extrinsic ratings in specialized competence, specialized importance, and utilization of configuration and data manager competence. These results indicate that the program managers (extrinsic) ratings in these areas were approximately equivalent to the configuration and data manager intrinsic (self) ratings. However, a significant difference was noted in the ratings of specialized aptitude, in that configuration and data

managers rated their own aptitude higher than the extrinsic ratings generated by program managers. The difference between aptitude ratings is not unexpected since in general, an external observer is better qualified to judge an individual's inquisitiveness rather than the individual evaluating his own inquisitiveness. Therefore the questionnaire overall was not biased between groups.

V. Conclusions and Recommendations

Introduction

The objective of this research project was to identify potential solutions to the problem of limited productivity within the matrix-structured environment, and subsequently, to recommend strategies for enhanced organizational productivity in the configuration and data management area. This chapter contains strategies for productivity enhancements and recommendations for heightened matrix organizational productivity based on the significant findings of this project. Suggestions for future pertinent research are also proposed.

Assumptions and Limitations

Currently, a data collection device is not available which provides a definitive determination of an individual's true level of competence. Recognizing the absence of some essential, yet unmeasurable, indicators of competence, the survey instrument employed was determined to be the most suitable means available based on the current published literature. The data collection device for this project, and the modifications (detail information) made to the device to tailor it for this project, were validated by configuration and data management experts. Survey data was subjected to statistical analysis to assess validity. The results of the validity assessment are presented in chapter four.

Conclusions

The goal of this research was to determine factors, if any, which may contribute to decreased productivity within the matrixed configuration and data management functional office. Among factors identified by this project which contribute to decreased productivity, the non-utilization of configuration and data managers by respective program managers, regardless of competence, and the physical non-availability of configuration and data managers to those program managers are the two greatest concerns. Correction can only be accomplished by changing the competence perceptions of the program manager and by assuring the program manager that the configuration and data manager is familiar with program issues and readily available. Efforts to improve the competence of the configuration and data managers through the implementation of plans to enhance their educational level, aptitude or specialized competence will be ineffective unless they are complemented by organizational changes which make the configuration and data manager immediately available to the program manager when needed. The enhancements, by themselves, will not guarantee that the configuration and data functional will be utilized more and hence, that their productivity will improve.

While these improvements in availability and utilization may be difficult to achieve, there are other factors identified by this project which contribute to decreased productivity and which are more easily corrected. Two significant problems are the abundance of configuration and data management trainees and the non-standard configuration and data management practices being used in the organizations. However, while action should be taken to assign more experienced personnel to these matrix organizations and to standardize the responsibilities and practices, unless the utilization/availability situation is corrected, productivity improvements are likely to be small. **Only when the configuration and data manager is readily available to a program manager who recognizes the "essentiality" of the role and contributions of configuration and data managers can improvements in other "competence" factors be implemented with expectation for significantly enhanced productivity.**

Productivity Enhancement Strategies

Regardless of which of the following recommendations are chosen, the following four strategies for productivity enhancement must be implemented.

First, as stated in chapter four of this thesis, program managers recognize the importance of configuration and data management, but they are generally unfamiliar with the

totality of the configuration and data manager's responsibilities. In order to correct this deficiency, the exposure of all program management personnel to configuration and data management practices must be increased by offering configuration and data management coursework to all program management personnel. The program managers must be convinced of the importance of involving the configuration and data manager in program activities. Exposure to configuration and data management coursework would apprise the program manager about the number and scope of the key configuration and data management roles and responsibilities (such as the data requirements review board, configuration audits, and engineering data management) and would increase the likelihood that they would utilize the configuration and data management functional.

Second, the findings of chapter four of this thesis discussed the fact that the configuration and data management staff office is subordinate to the functional deputy of engineering. For optimal functioning of the acquisition process, the staff agency must be able to independently direct and enforce policies concerning issues relating to configuration and data management. Specifically, the configuration and data management staff agency must be removed from the command of the functional deputy of engineering and given equal organizational status.

Third, educating "trainees" to the discipline of configuration and data management, as well as providing updating education (seminars) for qualified configuration and data managers, is essential. Insufficient training was identified as the major deficiency within the configuration and data management discipline. The Professional Continuing Education courses offered through AFIT are intended to provide trainees with a foundation on the general issues relating to configuration and data management. Configuration and data managers interviewed for this project did not believe that the engineering data and data management courses were achieving the intended objective. Further, advanced courses or training providing timely guidance on system program office problems are generally unavailable. A comprehensive education and training program in the work environment must be established and implemented to supplement the AFIT courses. The training program, generated and maintained through the staff agency, should be administrated by each system program office. Such training would ensure that configuration and data trainees are brought "up to speed" in a thorough and prompt manner. Periodic updating for experienced configuration and data personnel must also be accomplished through "refresher" courses or seminars, sponsored by the ASD configuration and data management staff agency. Refresher curricula must be

specifically directed to the new or changing aspects of configuration and data management.

Fourth, a standardized set of configuration and data management practices and procedures must be developed and enacted. Deviations from the standardized protocol will be allowed, with approval from the staff agency, to accommodate individual program uniqueness. Within and among each of the three organizations surveyed, a lack of standardization of configuration and data management procedures was clearly evident. Communication between configuration and data management organizations must be established and maintained, thereby ensuring that newly developed policies and procedures are implemented and followed and that new innovations are quickly shared with other configuration and data managers.

Recommendations

This research project proposes two alternative recommendations for enhanced matrix organizational productivity with respect to the configuration and data management area. Ultimately, enhanced productivity will be achieved by making changes to the organizational environment and the competence of the configuration and data management personnel assigned to the acquisition programs.

Recommendation Number One. The first and most effective recommendation proposes a re-structuring of the existing organizational framework, specifically by elimination of the current configuration and data manager support organizations in the matrix program offices. Based upon the research findings of this project (chapter four), configuration and data management duties are regarded as essential for successful program completion; however, utilization (uncontrollable) of the configuration and data manager is not regarded as essential. Organizational re-structuring should move the configuration and data manager from the configuration and data management office physically into the system program office (Figure 10 and 11). This move will increase their day-to-day contact (familiarity) with, and their availability to, the program and the program manager and is expected to increase the productivity and efficiency of both the system program office and the configuration and data management function. The close physical proximity of the program manager and the configuration and data manager is necessary and will serve to facilitate communication, will help to affirm competence and assure familiarity with the program, and will allow a precise agreement on expectations and responsibilities. The "non-essential" image of the configuration and data manager will unquestionably be diminished in an environment conducive to

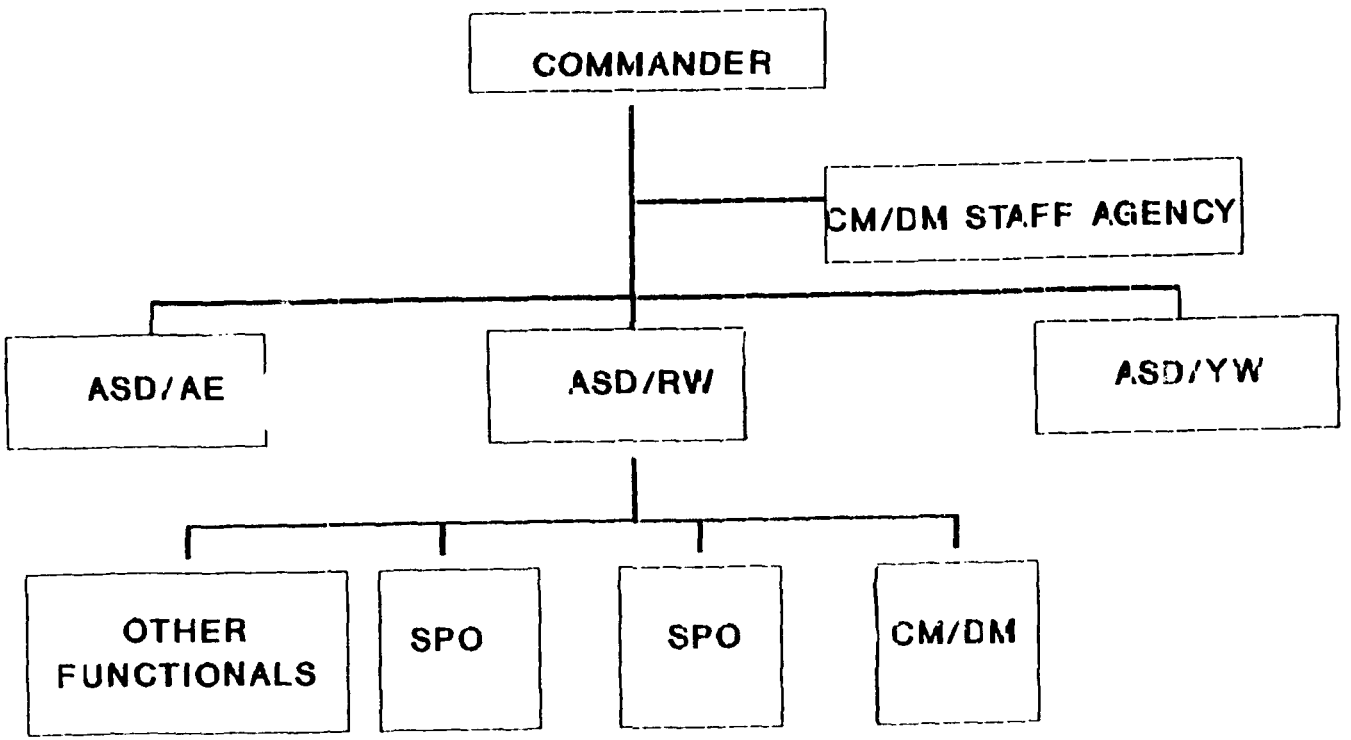

Figure 10. Current Organizational Structure

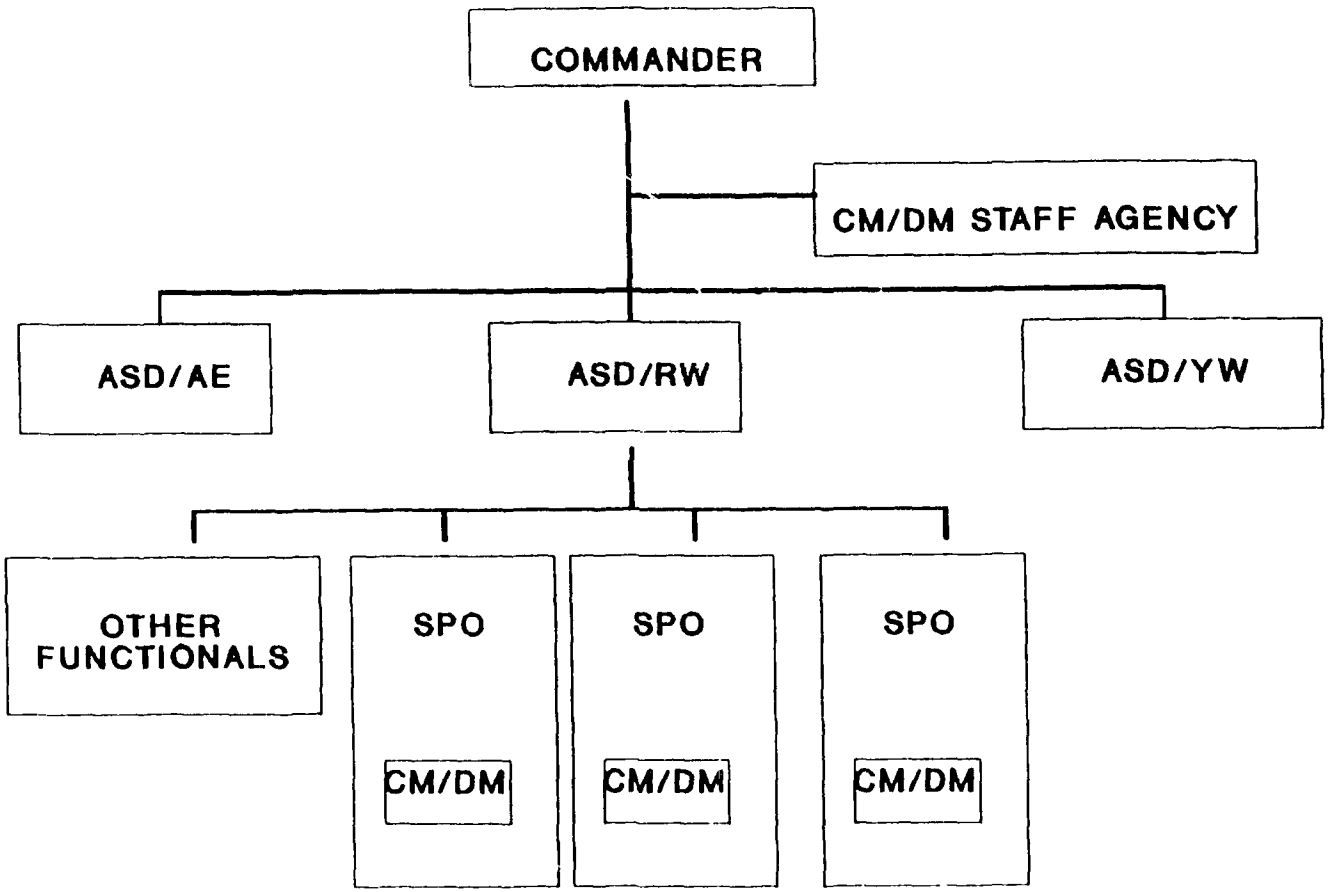

Figure 11. Proposed Organizational Structure

communication. Based upon the program manager's opportunity to observe and receive direct input from the available configuration and data manager, the utilization rate of the configuration and data manager functional will assuredly increase.

Vital to the successful enactment of this recommendation are the previously mentioned strategies for enhanced productivity. These strategies must be enacted concurrently with this recommendation.

Additionally, implementation of recommendation one would requires that the centralized training responsibility be accomplished by the staff agency. Trainees would be assigned in such a manner that existing, qualified configuration and data managers would be delegated the duty of orienting a trainee manager. Following comprehensive training, the newly oriented trainee manager would be transferred to a managerial vacancy within a system program office.

Many of the expert supervisory personnel currently in the configuration and data management office of the matrix program office could be transferred to an expanded staff agency. It will be the responsibility of these experts to create and administer an expanded training program, to standardize the configuration and data management practices and policies, to answer questions from system program

office's configuration and data managers, and to supplement system program office's configuration and data managers on major activities. However, some of the supervisory positions would be eliminated as configuration and data management positions are reclassified to meet the objectives of the ASD commander.

Implementation of this first recommendation would increase the efficiency and utilization of the configuration and data management duties in a short period of time. However, the major problem with executing this recommendation is the disruption of the current organizational structure and the loss of some top-level positions for configuration and data management personnel.

Recommendation Number Two. The second recommendation proposes enactment of the productivity enhancement strategies within the existing organizational structure. The overwhelming problem with this recommendation is that the factors affecting utilization and availability will neither be addressed adequately nor eliminated. As stated in the conclusions portion of this chapter, utilization and availability are the principal factors which limit productivity of the configuration and data management personnel. Unless the configuration and data managers are available to and utilized by program managers, the

consequential improvements based on those productivity enhancement strategies will have only a minor effect on increasing productivity within the matrixed configuration and data management functional office.

Suggestions for Future Research

The following areas are suggested for future pertinent research:

1. The method used in this research effort could be applied to a larger population of configuration and data managers in different organizational structures (functional and/or project). Perhaps a different environment will allow for the complete dismissal of the organizational structure as the problem of decreased productivity.

2. The method used in this research effort could be applied to configuration and data managers within commercial matrix structured organizations, such as a defense contractor organization. The application of a matrix organizational structure is certainly not unique to ASD. Problems similar to specialized competence must be encountered by defense contractors when preparing to meet program goals and adapt to changes in existing government contracts.

Summary

In this research effort, valuable information pertaining to the problem of limited productivity within configuration and data management was gained. The program manager's conscious exclusion (non-utilization) of both knowledgeable and trainee configuration and data managers coupled with the perceived non-availability of the configuration and data managers were identified as the major factors contributing to decreased productivity. Two recommendations are proposed to rectify the identified deficiencies within the configuration and data management area. Implementation of the first recommendation will fully remedy the situational deficiencies; however, executing the second recommendation will only partially increase productivity. Whether or not either of these recommendations is implemented will be determined by appropriate personnel. The upper echelon of officers must understand that the highest degree of efficiency is only achieved by maximizing the availability of and utilization of each functional area. Increased productivity begins with appropriate utilization of all available resources. Program managers must realize that, like other functionals, configuration and data management personnel are assets when properly utilized.

Appendix A: Definitions

Collocated. A type of assignment whereby a functional specialist is operationally assigned to a two-letter system program organization to meet a specific need. Collocated personnel are physically located with the two-letter organization and are responsible through appropriate channels to the organization deputy. Whether resources are further collocated to a three-letter organization is determined by agreement between the chief of the three-letter organization and the senior collocate. Collocation of employees should be considered whenever full-time support is needed from an employee for a period of over 90 days. (7:2)

Dedicated. An employee who is devoted to a specific program on a full-time basis as required by the program manager.

Functional Assignment (functionals). An employee whose job assignment is to a given functional area. For purposes of this study, functional assignment would be an employee who is working as a configuration and data manager (CM/DM).

Functional Deputy. A deputy (ie ASD/AC, ASD/EN, etc.) responsible for maintaining a body of expertise in a given functional area to be applied in support of acquisition activities (11:2).

Matrixing. The concept of classifying and assigning skills by functional area and collocating personnel with these skills to support program/project organizations (7:2).

Program Manager. An individual who is responsible for the progress of all facets of the program.

Specialized Aptitude: The individual's ability to assimilate new information as well as the natural tendency to personally engage in other than familiar areas and issues.

Specialized Competence: "an individual's feelings and confidence about his abilities in mastering an organizational and work settings" (34:451).

Specialized Training/Education: Training and education which is specifically directed at a functional area.

Appendix B: Configuration and Data Manager Survey Instrument

1. Educational Degree(s)

What is the highest level of education you have achieved? Are you presently enrolled in any educational courses? Any particular area of specialization?

2. Program Attributes

2.1 What phase is your program currently in (i.e., Concept Definition, Demonstration/Validation, Full Scale Development, Production and Deployment, or Operations Support)?

2.2 Are you presently working on more than one program?

2.3 Do you have time to do all that needs to be done in CM/DM area for the program? If not, what areas are being neglected?

3. Self-rated Specialized Competence

In the discussion that follows, the term "specialized competence" will be used. The meaning of that term is the ability to assimilate and use specialized information related to your specialty. Here, it applies specifically to your ability as a Configuration and Data Manager to understand specialized CM/DM concepts at a level of detail commensurate with your management position and to properly factor that knowledge into your decision making. The specialized competence you have may be due to a variety of factors such as education. experience, and your own intrinsic aptitude. Please keep in mind that the following questions do not deal with how well you do your job as a Configuration and Data Manager. The focus is how comfortable you are with your own ability to deal with specialized issues.

3.1 How well do you meet your own personal expectations for CM/DM specialized expertise in doing this job?

a. How comfortable do you handle specifications? What baseline are you currently monitoring? Do you think that the following actions are something a CM/DM should be doing? Do you think that this task is something the program manager should be doing? On your program, who actually performs these actions?

Coordinate specification review
Control file copies
Review specification for content
Review specification for format

b. How comfortable are you working with CDRLs? How many changes have you accomplished during the last year? Do you think that the following actions are something a CM/DM should be doing? Do you think that this task is something the program manager should be doing? On your program, who actually performs these actions?

Make Data Call
Run Data Requirements Review Board
Monitor Data Submittal
Approve Data Format

c. How do you feel about handling the ECP process? How many CCB have you participated in during the last year? Do you think that the following actions are something a CM/DM should be doing? Do you think that this task is something the program manager should be doing? On your program, who actually performs these actions?

Coordinate ECP Review
Conduct Technical Coordinating Meeting
Brief CCB to program manager
Gather information to support the program manager CCB brief

d. How comfortable do you understand the aspects of a configuration audit? How many audits have you attended? Do you think that the following actions are something a CM/DM should be doing? Do you think that this task is something the program manager should be doing? On your program, who actually performs these actions?

Coordinate All Technical Arrangements
Chair the Audits
Record/Track all Write-ups
Sign the Minutes

e. How comfortable do you handle Status Accounting? How do you track change processing? Do you think that the following actions are something a CM/DM should be doing? Do you think that this task is something the program manager should be doing? On your program, who actually performs these actions?

Approve the System
Manage the Data
Focal point for Problems

f. How comfortable do you handle the engineering drawings process? Who is the engineering data manager on your program? Do you think that the following actions are something a CM/DM should be doing? Do you think that this task is something the program manager should be doing? On your program, who actually performs these actions?

Establish Control Requirements
Review Preliminary Drawings
Chair Interim Program Reviews (IPR)
Approve Drawings

g. How comfortable do you understand the regulations associated with data rights? What level of drawings are required on your program? Do you think that the following actions are something a CM/DM should be doing? Do you think that this task is something the program manager should be doing? On your program, who actually performs these actions?

Determine Contract Requirements
Determine Violations
Focal Point for Concerns

3.2 Imagine that the configuration and data manager had apprentices. To what degree would the CM/DM specialized competence you exhibit be a good model for your apprentice?

3.3 To what extent are your talents, or the places you can concentrate your attention, in areas other than CM/DM aspects of the program. If so, which functional area is your attention placed in?

3.4 Considering the time you have spent in your position, how familiar are you with the following key CM/DM aspects of the program?

a. Statement of Work
b. Special Contractual Requirements
c. Contract Data Requirements List
d. Program Schedule/Milestones

3.5 Do you feel you have all the CM/DM specialized skills you need to perform well in your job? Do you have any weak areas?

3.6 How do you compare in CM/DM specialized competence to: other configuration and data managers in your SPO?; in similar SPOs?; in ASD?

3.7 How do you compare in the level of specialized competence (CM/DM) with the other functional experts on the program?

3.8 How much does the program manager utilize your specialized CM/DM competence? Do you attend program reviews? If so, which ones?

4. Self-rated Aptitude

4.1 How strong is your natural tendency to ask questions or solicit information concerning non-CM/DM aspects of your program? If strong tendency, which functionals do you correspond with?

4.2 How quickly would you say you "come up to speed" as far as understanding CM/DM related specialized information that is new to you? For example, how familiar are you with:

a. DoD-STD-2167
b. Engineering Data Requirements File
c. Software Documentation

5. Importance of Specialized Competence

Assume you got notification to leave this job within sixty days and were involved in choosing your replacement.

5.1 How important a consideration do you think it should be that your replacement have a high level of specialized CM/DM competence?

5.2 Suppose the person chosen to replace you had a great deal of acquisition and management experience but little CM/DM experience and had trouble grasping CM/DM specialized issues. Do you think his lack of specialized CM/DM ability might be a serious detriment to your program? If so, at what position level(s)?

6. Suggestions for the Betterment

6.1 In your opinion, what attributes should a configuration and data manager (specialist) possess in order to perform his job?

a. Education (level)
b. Experience (years)
c. Experience (area)
d. Age (years)
e. Sex (male/female)
f. CM/DM Knowledge

6.2 In your opinion, the most capable CM/DMs possesses understanding in which functional background(s)?

a. Engineering
b. Logistics
c. Contracting
d. Administration
e. Program Control
f. Other

6.3 Specialized CM/DM Training/Education Suggestions

What kinds of specific specialized areas do you believe may warrant increased emphasis in the training and education of personnel who will become configuration and data managers of the future?

a. Software Documentation
b. Software languages (PDL, Ada, Cobol, etc)
c. Engineering drawings regulations
d. Systems Engineering Application
e. Automated Data Bases
f. Auditing CAD/CAM items
g. Software Independent Verification/Validation
h. Other

Appendix C: Configuration and Data Manager Collection Sheet

Program: _____
Configuration and Data Manager Name: _____
Rank/Grade: _____
Program Manager Name: _____
Organization: _____

1. Educational Level Category: _____

A. Beyond Bachelor.
B. Technical Bachelor.
C. Non-technical Bachelor.
D. Associate Degree.
E. High School Diploma.

Educational Field
Technical
Business
Sciences

Comments:

2.1 Program Phase Category: _____

A. Concept Definition
B. Demonstration/Validation
C. Full Scale Development
D. Production
E. Operation Support

2.2 Workload Rating: _____

Rating Scale:
1. Dedicated to one program
2. Dedicated to more than one program

2.3 Time Requirements Rating: _____

Rating Scale:
1. Strongly Agree
2. Agree
3. Neutral
4. Disagree
5. Strongly Disagree

Comments:

3. Self-Rated Specialized Competence Rating: _____

3.1. Personal Expectations Rating: _____

Rating Scale:
00-14. Not very well
15-19. Marginally
20-24. Adequately
25-29. Fairly well
30-35. Extremely well

3.1.a Specification Rating: _____

Baseline: F A P N/A

	CM/DM	PM	Actual:
Coordinate specification review			
Control file copies			
Review specification for content			
Review specification for format			

Comments:

3.1.b Contract Data Requirements List Rating: _____

Number of Changes: _____

	CM/DM	PM	Actual:
Make Data Call			
Run Data Requirements Review Board			
Monitor Data Submittal			
Approve Data Format			

Comments:

3.1.c Engineering Change Proposals Rating: _____

Number of CCBs: _____

	CM/DM	PM	Actual:
Coordinate ECP Review			
Conduct Technical Coordinating Meeting			
Brief CCB to program manager			
Gather information to support the program manager CCB brief			

Comments:

3.1.d Configuration Audits Rating: _____

Number of Audits: _____

	CM/DM	PM	Actual:
Coordinate All arrangements			
Chair the Audits			
Record/Track all write-ups			
Sign the Minutes			

Comments:

3.1.e Status Accounting Rating: _____

Tracking: Manual Automated

	CM/DM	PM	Actual:
Approve the System			
Manage the Data			
Focal point for Problems			

Comments:

3.1.f Engineering Drawings Rating: _____

EDMO: CM/DM Staff PM

	CM/DM	PM	Actual:
Establish Control Requirements			
Review Preliminary Drawings			
Chair Interim Program Reviews			
Approve Drawings			

Comments:

3.1.g Data Rights Rating: _____

Level of Drawings: _____

	CM/DM	PM	Actual:
Determine Contract Requirements			
Determine Violations			
Focal Point for Concerns			

Comments:

3.2 Model for Apprentice Rating: _____

Rating Scale:
00-14. Poor Model
15-19. Fair Model
20-24. Acceptable Model
25-29. Pretty Good Model
30-35. Exceptional Model

Comments:

3.3 Talents Elsewhere Rating: _____

Rating Scale:
00-14. Far more talented in other areas
15-19. More talented in other areas
20-24. Balanced
25-29. Specialized leaning
30-35. Most talented in specialized aspects

Comments:
a. Engineering
b. Logistics
c. Manufacturing
d. Contracting
e. Other

3.4 Familiarity Considering Time Rating: _____

Rating Scale:
00-14. Not familiar at all
15-19. Somewhat familiar
20-24. Familiar with key issues
25-29. Quite familiar with key issues
30-35. Very familiar with all issues

3.4.a Statement of Work Rating: _____

Rating Scale:
00-14. Not familiar at all
15-19. Somewhat familiar
20-24. Familiar with key issues
25-29. Quite familiar with key issues
30-35. Intimately familiar with all issues

3.4.b Special Contractual Requirements Rating: _____

3.4.c Contract Data Requirements List Rating: _____

3.4.d Program Schedule/Milestones Rating: _____

3.5 Specialized Skills Rating: _____

Rating Scale:
00-14. Do not have needed specialized skills at all
15-19. Need more specialized skill to perform well
20-24. Have some specialized skills but more would be helpful
25-29. Have most of needed specialized skills
30-35. Have all of the specialized skills needed to perform well

Weak Areas:

3.6 Comparisons Rating: _____

3.6.a SPO comparisons Within Specialized Rating: _____

Rating Scale:
1. Below Average Level
2. Average
3. Above Average Level

3.6.b Similar SPO comparisons Rating: _____

3.6.c ASD comparisons within Specialized Rating: _____

3.7 Comparisons with other Functionals Rating: _____

Rating Scale:
1. Below Average Level
2. Average
3. Above Average Level

3.8 Utilization Factors Rating: _____

Rating Scale:
00-14. Never
15-19. Rarely
20-24. Occasionally
25-29. Frequently
30-35. Constantly

Comments:

4. Self-Rated Specialized Aptitude

4.1 Propensity to Question Rating: _____

Rating Scale:
00-14. Do not seek information
15-19. Occasionally inquire about issues
20-24. Question specialized matters about issues
25-29. Tend to ask questions until comfortable
30-35. Ask questions until fully understood

Comments:
a. Contractual
b. Engineering
c. Logistics
d. Manufacturing
e. Other

4.2 Quickness in Learning Rating: _____

Rating Scale:
00-14. Do not understand specialized matters
15-19. Not a strong point, but will understand
20-24. Average quickness
25-29. Above average quickness
30-35. Extremely quick in absorbing information

4.2.a DoD-STD-2167

Rating Scale: Rating: _____
00-14. Not familiar at all
15-19. Somewhat familiar
20-24. Familiar with key issues
25-29. Quite familiar with key issues
30-35. Intimately familiar with all issues

4.2.b Engineering Data Requirements File Rating: _____

4.2.c Software Documentation Rating: _____

5. Importance of Specialized Competence

5.1 Importance Rating: _____

Rating Scale:
00-14. Not a factor at all
15-19. Not a very important factor
20-24. Even with other factors
25-29. One of the most important factors
30-35. Most important factor

5.2 Detriment Potential Rating: _____

Rating Scale:
00-14. Would not make a difference at all
15-19. Would be unfortunate, but not seriously harm program
20-24. Would be a detriment, but not serious
25-29. Would be likely to hinder the program
30-35. Would seriously hinder program

Position Level	Entry	Specialist	Supervisor

6. Suggestions

6.1 Attributes

	Yes	No
a. Education (level)		
b. Experience (years)		
c. Experience (area)		
d. Age (years)		
e. Sex (male/female)		
f. Job Knowledge		

Comments:

6.2 Proficient CM/DMs

	Unimportant	Helpful	Important
a. Engineering			
b. Logistics			
c. Contracting			
d. Administration			
e. Program Control			
f. Other			

6.3 Specialized CM/DM Areas/Education

	Yes	No
a. Software Documentation		
b. Software languages (PDL, Ada, Cobol, etc)		
c. Engineering drawings regulations		
d. Systems Engineering Application		
e. Automated Data Bases		
f. Auditing CAD/CAM items		
g. Software Independent Verification/Validation		
h. Other		

Appendix D: Program Manager Survey Instrument

1. Perceived CM/DM Specialized Competence

In the discussion that follows, the term "specialized competence" will be used. The meaning of that term is the ability to assimilate and use specialized information. Here, it applies specifically to the ability of the Configuration and Data Manager supporting your program to understand specialized CM/DM concepts at a level of detail commensurate with their position and to properly apply that knowledge in the support of your decision making. Their specialized CM/DM competence may be due to a variety of factors such as education, experience, and their own intrinsic aptitude.

1.1 How well does the configuration and data manager meet your expectation for the following specialized areas in doing his job? Do you think that the following sub-activities are something a CM/DM should be doing? Do you think that the activities is something you should be doing? On your program, who actually performs these actions?

a. Specification Maintenance
   Coordinate specification review
   Control file copies
   Review specification for content
   Review specification for format

b. Contract Data Requirements List
   Make Data Call
   Run Data Requirements Review Board
   Monitor Data Submittal
   Approve Data Format

c. Engineering Change Proposals
   Coordinate ECP Review
   Conduct Technical Coordinating Meeting
   Brief CCB to program manager
   Gather information to support the program manager
   CCB brief

d. Configuration Audits
   Coordinate All arrangements
   Chair the Audits
   Record/Track all write-ups
   Sign the Minutes

e. Status Accounting
   Approve the System
   Manage the Data
   Focal point for Problems

f. Engineering Drawings
   Establish Control Requirements
   Review Preliminary Drawings
   Chair Interim Program Reviews
   Approve Drawings

g. Data Rights
   Determine Contract Requirements
   Determine Violations
   Focal Point for Concerns

1.2 Suppose configuration and data manager had apprentices. Would the CM/DM specialized competence exhibited by your configuration and data manager make a good model for an apprentice to emulate?

1.3 To what extent do you feel the configuration and data manager's talents, or where he can concentrate his attention best, are in areas other than CM/DM specialized aspects of the program?

1.4 Considering the time spent in the job, do you feel the configuration and data manager is thoroughly familiar with the key CM/DM aspects of the program defined in the:

a. Statement of Work
b. Special Contractual Requirements
c. Contract Data Requirements List
d. Program Schedule/Milestones

1.5 Do you think the configuration and data manager has all the specialized CM/DM skills he needs to perform well in his job? Does the CM/DM have any weak areas?

1.6 How does the configuration and data manager compare in CM/DM specialized competence to the previous configuration and data manager?

1.7 How does the configuration and data manager compare in degree of specialized competence to other functional experts on your program?

1.8 How much do you utilize your configuration and data manager's specialized CM/DM competence? In what areas?

2. Configuration and Data Manager Aptitude

2.1 How much do you feel the configuration and data manager has a natural tendency to ask questions or solicit information concerning the non-CM/DM aspects of the program? If strong tendency, which areas?

2.2 How quickly does the configuration and data manager "come up to speed" as far as understanding related specialized CM/DM information that is new to him?

a. DoD-STD-2167
b. Engineering Data Requirements File
c. Software Documentation

3. Importance of Specialized Competence

Assume the configuration and data manager received notification to leave within sixty days and that you were involved in choosing his replacement.

3.1 How important a consideration do you think it should be that his replacement have a high level of specialized CM/DM competence?

3.2 Suppose the person chosen to replace him had a great deal of acquisition and management experience but little CM/DM experience and had trouble grasping CM/DM specialized issues. Do you think his lack of specialized ability might be a serious detriment to the program? If so, at what position level?

4. Suggestions for the Betterment

4.1 In your opinion, what attributes should a configuration and data manager possess in order to perform his job?

4.2 In your opinion, do capable CM/DMs come from any specific functional background? If so, which functional?

4.3 Specialized Training/ Education Suggestions

What specific specialized CM/DM areas do you believe may warrant increased emphasis in the training and education of personnel who will become configuration and data manager of the future?

a. Software Documentation
b. Software languages (PDL, Ada, Cobol, etc)
c. Engineering drawings regulations
d. Systems Engineering Application
e. Automated Data Bases
f. Auditing CAD/CAM items
g. Software Independent Verification/Validation
h. Other

Appendix E: Program Manager Collection Sheet

Program: _____
Configuration and Data Manager Name: _____
Program Manager Name: _____
Rank/Grade: _____
Organization: _____

1. CM/DM Specialized Competence Rating: _____

1.1. Personal Expectations Rating: _____

Rating Scale:
00-14. Not very well
15-19. Marginally
20-24. Adequately
25-29. Fairly well
30-35. Extremely well

1.1.a Specification Rating: _____

Rating Scale:
00-14. Not very well
15-19. Marginally
20-24. Adequately
25-29. Fairly well
30-35. Extremely well

	CM/DM	PM	Actual:
Coordinate specification review			
Control file copies			
Review specification for content			
Review specification for format			

Comments:

1.1.b Contract Data Requirements List Rating: _____

	CM/DM	PM	Actual:
Make Data Call			
Run Data Requirements Review Board			
Monitor Data Submittal			
Approve Data Format			

Comments:

1.1.c Engineering Change Proposals Rating: _____

	CM/DM	PM	Actual:
Coordinate ECP Review			
Conduct Technical Coordinating Meeting			
Brief CCB to program manager			
Gather information to support the program manager CCB brief			

Comments:

1.1.d Configuration Audits Rating: _____

	CM/DM	PM	Actual:
Coordinate All arrangements			
Chair the Audits			
Record/Track all write-ups			
Sign the Minutes			

Comments:

1.1.e Status Accounting Rating: _____

	CM/DM	PM	Actual:
Approve the System			
Manage the Data			
Focal point for Problems			

Comments:

1.1.f Engineering Drawings Rating: _____

	CM/DM	PM	Actual:
Establish Control Requirements			
Review Preliminary Drawings			
Chair Interim Program Reviews			
Approve Drawings			

Comments:

1.1.g Data Rights Rating: _____

CM/DM PM Actual:

Determine Contract Requirements
Determine Violations
Focal Point for Concerns

Comments:

1.2 Model for Apprentice Rating: _____

Rating Scale:
00-14. Poor Model
15-19. Fair Model
20-24. Acceptable Model
25-29. Pretty Good Model
30-35. Exceptional Model

1.3 Talents Elsewhere Rating: _____

Rating Scale:
00-14. Far more talented in other areas
15-19. More talented in other areas
20-24. Balanced
25-29. Specialized leaning
30-35. Most talented in specialized aspects

1.4 Familiarity Considering Time Rating: _____

Rating Scale:
00-14. Not familiar at all
15-19. Somewhat familiar
20-24. Familiar with key issues
25-29. Quite familiar with key issues
30-35. Intimately familiar with all issues

1.4.a Statement of Work Rating: _____

Rating Scale:
00-14. Not familiar at all
15-19. Somewhat familiar
20-24. Familiar with key issues
25-29. Quite familiar with key issues
30-35. Very familiar with all issues

1.4.b Special Contractual Requirements Rating: _____

1.4.c Contract Data Requirements List Rating: _____

1.4.d Program Schedule/Milestones Rating: _____

1.5 Specialized CM/DM Skills Rating: _____

Rating Scale:
00-14. Do not have needed specialized skills at all
15-19. Need more specialized skill to perform well
20-24. Have some specialized skills but more would be helpful
25-29. Have most of needed specialized skills
30-35. Have all of the specialized skills needed to perform well

Comments:

1.6 Comparisons to Previous CM/DM Rating: _____

Rating Scale:
1. Below Average Level
2. Average
3. Above Average Level

1.7 Comparisons to Other Functionals Rating: _____

Rating Scale:
1. Below Average Level
2. Average
3. Above Average Level

1.8 Utilization Factors Rating: _____

Rating Scale:
00-14. Never
15-19. Rarely
20-24. Occasionally
25-29. Frequently
30-35. Constantly

Comments:

2. CM/DM Aptitude Rating: _____

2.1 Propensity to Question Rating: _____

Rating Scale:
00-14. Do not seek information
15-19. Occasionally inquire about issues
20-24. Question specialized matters about issues
25-29. Tends to ask questions until comfortable
30-35. Ask questions until fully understood

Comments:

2.2 Quickness in Learning Rating: _____

Rating Scale:
00-14. Do not understand specialized matters
15-19. Not a strong point, but will understand
20-24. Average quickness
25-29. Above average quickness
30-35. Extremely quick in absorbing information

Comments:

2.2.a DoD-STD-2167

Rating Scale: Rating: _____
00-14. Not familiar at all
15-19. Somewhat familiar
20-24. Familiar with key issues
25-29. Quite familiar with key issues
30-35. Intimately familiar with all issues

2.2.b Engineering Data Requirements File Rating: _____

2.2.c Software Documentation Rating: _____

3. Importance of Specialized Competence

3.1 Importance Rating: _____

Rating Scale:

00-14. Not a factor at all
15-19. Not a very important factor
20-24. Even with other factors
25-29. One of the most important factors
30-35. Most important factor

3.2 Detriment Potential Rating: _____

Rating Scale:

00-14. Would not make a difference at all
15-19. Would be unfortunate, but not seriously harm program
20-24. Would be a detriment, but not serious
25-29. Would be likely to hinder the program
30-35. Would definitely seriously hinder program

Position Level	Entry	Specialist	Supervisor

4. Suggestions

4.1 Attributes

	Yes	No
a. Education (level)		
b. Experience (years)		
c. Experience (area)		
d. Age (years)		
e. Sex (male/female)		
f. Job Knowledge		

Comments:

4.2 Proficient CM/DMs

	Unimportant	Helpful	Important
a. Engineering			
b. Logistics			
c. Contracting			
d. Administration			
e. Program Control			
f. Other			

4.3 Specialized CM/DM Areas/Education

	Yes	No
a. Software Documentation		
b. Software languages (PDL, Ada, Cobol, etc)		
c. Engineering drawings regulations		
d. Systems Engineering Application		
e. Automated Data Bases		
f. Auditing CAD/CAM items		
g. Software Independent Verification/Validation		
h. Other		

Appendix F: Competency Ratings (Intrinsic and Extrinsic) Versus Educational Background and Organizations

Educational Background Comparison

	CM/DM TECH	PM TECH	CM/DM ASSOC	PM ASSOC	CM/DM HIGH	PM HIGH
1.	29.000	31.000	26.000	28.000	27.000	24.000
2.	33.000	29.000	26.000	27.000	20.000	20.000
3.	30.000	31.000	29.000	27.000	21.000	20.000
4.	28.000	32.000	24.000	27.000	24.000	24.000
5.	31.000	28.000	34.000	33.000	27.000	24.000
6.	34.000	32.000	29.000	30.000	28.000	23.000
7.	34.000	34.000	28.000	25.000	20.000	20.000
8.	31.000	30.000	27.000	25.000	29.000	29.000
9.	34.000	34.000			25.000	24.000
10.					26.000	23.000

Organizational Comparison

	CM/DM RW	PM RW	CM/DM YW	PM YW	CM/DM AE	PM AE
1.	29.000	31.000	29.000	27.000	34.000	34.000
2.	33.000	29.000	24.000	27.000	29.000	29.000
3.	30.000	31.000	27.000	24.000	25.000	24.000
4.	28.000	32.000	24.000	24.000	29.000	30.000
5.	31.000	28.000	34.000	33.000	28.000	23.000
6.	26.000	28.000	28.000	25.000	26.000	23.000
7.	27.000	24.000	20.000	20.000	27.000	25.000
8.	26.000	27.000	34.000	34.000	31.000	30.000
9.	34.000	32.000				
10.	20.000	20.000				
11.	21.000	20.000				

Appendix G: Numerical Results from the Questionnaires of Roles and Opinions

Specification

	Intrinsic		Extrinsic	
	CM/DM	PM	CM/DM	PM
Coordinate specification review	24	03	27	00
Control file copies	25	02	27	00
Review specification for content	13	14	03	24
Review specification for format	27	00	27	00

Contract Data Requirements List

	Intrinsic		Extrinsic	
	CM/DM	PM	CM/DM	PM
Make Data Call	27	00	27	00
Run Data Requirements Review Board	14	13	20	07
Monitor Data Submittal	27	00	27	00
Approve Data Format	27	00	27	00

Engineering Change Proposals

	Intrinsic		Extrinsic	
	CM/DM	PM	CM/DM	PM
Coordinate ECP Review	15	12	08	19
Conduct Tech Coordinating Meeting	13	14	16	11
Brief CCB to program manager	18	09	20	07
Gather information to support the program manager CCB brief	27	00	27	00

Configuration Audits

	Intrinsic		Extrinsic	
	CM/DM	PM	CM/DM	PM
Coordinate All arrangements	22	05	24	03
Chair the Audits	25	02	20	07
Record/Track all write-ups	27	00	27	00
Sign the Minutes	17	08	20	07

Status Accounting

	Intrinsic		Extrinsic	
	CM/DM	PM	CM/DM	PM
Approve the System	27	00	27	00
Manage the Data	27	00	27	00
Focal point for Problems	24	03	13	14

Engineering Drawings

	Intrinsic		Extrinsic	
	CM/DM	PM	CM/DM	PM
Establish Control Requirements	24	03	25	02
Review Preliminary Drawings	25	02	25	02
Chair Interim Program Reviews	06	21	00	27
Approve Drawings	Not Applicable			

Data Rights

	Intrinsic		Extrinsic	
	CM/DM	PM	CM/DM	PM
Determine Contract Requirements	24	03	26	01
Determine Violations	10	17	08	19
Focal Point for Concerns	27	00	27	00

Suggestions

Attributes

	CM/DM	PM
a. Education (level)		
Technical	12	23
Associate	06	04
High School	09	00
b. Experience (years)		
0-2	04	02
2-5	10	15
5+	13	10
c. Experience (area)		
Engineering	12	21
Logistics	13	04
Manufacturing	02	02
d. Age (years)		
18-30	Not a factor	
31-40		
50+		
e. Sex (male/female)		
Male	Not a factor	
Female		

Proficient CM/DMs

Configuration and Data Manager's Responses

	Unimportant	Helpful	Important
a. Engineering	03	09	15
b. Logistics	05	10	12
c. Contracting	12	13	02
d. Administration	17	08	02
e. Program Control	20	04	03

Program Manager's Responses

	Unimportant	Helpful	Important
a. Engineering	00	03	24
b. Logistics	00	14	13
c. Contracting	15	07	05
d. Administration	13	08	09
e. Program Control	18	03	06

Specialized CM/DM Areas/Education

Configuration and Data Manager's Responses

	Yes	No
a. Software Documentation	25	02
b. Software languages (PDL, Ada, Cobol, etc)	10	17
c. Engineering drawings regulations	26	01
d. Systems Engineering Application	24	03
e. Automated Data Bases	22	05
f. Auditing CAD/CAM items	05	22
g. Software Independent Verification/Validation	04	23

Program Manager's Responses

	Yes	No
a. Software Documentation	22	05
b. Software languages (PDL, Ada, Cobol, etc)	00	27
c. Engineering drawings regulations	20	07
d. Systems Engineering Application	25	02
e. Automated Data Bases	27	00
f. Auditing CAD/CAM items	12	15
g. Software Independent Verification/Validation	00	27

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Wright-Patterson AFB OH 45433-6583

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This study explored how the productivity of a configuration and data management division within a matrix organization can be improved and subsequently recommended strategies for increased productivity. A modified Wagner and Morse questionnaire facilitated data collection. Information and ratings were gathered through personal interviews with the configuration and data managers and their respective program managers (matched-pair) concerning specialized competence, aptitude, utilization and importance. Additionally, this study identified situational factors which may serve to increase a configuration and data manager's competence rating.

Significant findings of this research were: (1) the configuration and data manager is relatively insignificant when compared to other functional program personnel; (2) there are few sufficiently knowledgeable configuration and data management personnel; (3) the program manager possesses an inadequate understanding of the duties performed by a configuration and data manager; and (4) utilization of a configuration and data manager is unrelated to the individual's competency level.

Two alternative recommendations were proposed for increased productivity and efficiency of the configuration and data management area:

The first recommendation proposes a major re-structuring of the existing configuration and data management support structure by which configuration and data managers would be transferred to work in the system program office.

The second recommendation proposes that the current organizational structure in which the configuration and data management personnel work in not be disrupted.

Four strategies for enhanced productivity are subsequently proposed to assist in the implementation of either recommendation.